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UTILIZATION OF SOLAR ENERGY

THE main sources from which energy is at present drawn are coal and oil, and it has been estimated that, at the present rate at which these resources are being exhausted, they are not likely to last much more than a few thousand years. A great deal of attention has therefore been paid to the possibility of obtaining power from such perennial sources as running water, the tides and solar energy. It is known that the earth receives a large amount of thermal energy in the form of solar radiation and although there has been much speculation as to the possibility of extracting useful work from this, the problem has not been critically examined in the past. A Committee was recently appointed by the Department of Scientific and Industrial Research of the United Kingdom to investigate this question and their report has recently been published.* According to this report, it seems unlikely that solar energy can be an important source of heat or power in

the near future, though some applications may be possible in specially favourable circumstances.

Although the final conclusion of the Committee thus appears to be not encouraging, the report contains a large amount of valuable information, and it may be worthwhile mentioning some of those here.

Available Energy.—The amount of heat arriving from the sun at the outside of the earth's atmosphere varies only slightly, and is on the average 1.35 kw/m^2 . The amount of energy reaching the ground near sea-level depends on the sun's altitude, the cloudiness and the state of the atmosphere. The maximum of direct radiation on a surface normal to the sun's rays on very clear days reaches 83 per cent. of the incident energy (1.12 kw/m^2) at Ouargla in Algeria. At Kew it is 70 per cent.; other stations give values between these. However, these maxima are rarely attained, and are only useful in estimating the maximum capacity of the plant necessary to make full use of the available energy. The use that can be made of this energy will now be considered.

* Report of the National Physical Laboratory Committee sponsored by the D.S.I.R., Great Britain.

Heating.—Solar water heaters have been on the market in the United States for many years but are used only on a limited scale. The reason is probably that the cost of water heating by other means is not high enough to make the capital expenditure on a solar heater and large storage tank in addition to the normal gas or oil heater seem worthwhile. It is possible that in England where fuel for private consumption is rationed, such heaters could be sold, but even here the competition from unrationed gas and electricity would probably be too severe. It seems unlikely that a campaign to encourage the sale of such heaters would result in a large enough saving of fuel to justify the capital cost. There is no prospect of substantial improvement of existing equipment by research and development.

In the tropics, hot water can be obtained for shower baths, etc., by very simple arrangements. The factor limiting the wide use of such installations is probably the absence in many places of piped water-supply and the lack of demand for hot water.

Cooking.—No one is likely to cook by solar energy if he can get gas, electricity, fuel oil, coal or wood. In some regions, however, none of these are freely available and it is possible that solar energy might find an application there. Cooking in itself does not consume much energy once the food has been brought up to the appropriate temperature. It might well be feasible to construct a solar stove which could satisfy part of the needs of the inhabitants of India, whose main meal is cooked at mid-day and generally consists of boiled rice or some kind of lentils. By designing a stove with suitable insulation to prevent excessive heat losses, it should be possible to reach and maintain temperatures of boiling water with 100 watts; this heat could be collected by a mirror of about 0.3 square metre.

A stove using a mirror and a pressure cooker has been built by the Indian National Physical Laboratory. There is no doubt that it is technically possible to cook food in this way, but it is not certain that the machine can be built at a price which an Indian villager can pay.

Refrigeration.—It seems impracticable to use solar energy directly as the sole source of power for a domestic refrigerator for preserving food, since its operation must be continuous. If another source of power is available the amount required is so small that it would not be worth using solar energy to save part of it. For areas where electric power is not available, refrigerators running on paraffin can be employed.

The use of solar energy for air-conditioning is more attractive, as it is not essential that the system runs continuously. There are well known refrigeration cycles in which heat is pumped out at the cold end and absorbed into the machine at the hot end so it would not be necessary to convert the heat into mechanical energy. It is difficult to estimate the amount of heat required without detailed consideration of design.

Power.—Owing to the intermittency of the supply, the direct use of solar energy for driving engines need not be considered for large power plants. There is, however, a number of purposes for which intermittent power as low as 1 kw would be useful. In particular, the economy of the Indian village might be profoundly affected by the availability of such prime movers for water pumping. Their use for driving the small looms employed in cottage industries has been suggested, but the intermittency of the supply makes it doubtful if they would be acceptable for this purpose. We are thus regretfully forced to the conclusion that orthodox heat engines driven directly by solar power are not an immediate practicable proposition.

Production of Fuel.—The use of solar energy to produce fuel which is subsequently used in an engine is attractive, as it avoids the consequences of the intermittency of sunlight and allows the energy to be used in applications requiring the continuous production of power. The efficiency of the utilization of sunlight by growing plants is remarkable. *Eucalyptus globulus* in India gives 2.4 kilograms of wood per year per square metre (9.4 tons/acre year). The wood has a calorific value of 2.1×10^4 joules/gm. (5,000 cal./gm.). The rate of storage of energy in the wood of an Indian eucalyptus forest is therefore 1.6 w/m² or 0.8 per cent. of the energy reaching the ground.

An estimate can be made of the possibilities of the wood fired steam engine for irrigation. If it is assumed that the land to be irrigated requires during the year the equivalent of 0.5 m of water to be raised from a depth of 10 m, it can be shown that the amount of land required for growing fuel for the engine is about 1/50 of the area to be irrigated. The value assumed for yield is what would be obtained under good conditions and is substantially greater than would be expected from peasant holdings. Even if a factor of 5 is allowed on account of optimistic assumptions, the project still seems practicable.

Distillation of Water.—There is scope for the solar distillation of water for drinking purposes

in certain tropical areas. On the assumption that an average of 0.15 kw/m^2 of radiant energy is available, the evaporation by direct distillation at 100°C. would be approximately 5 kilograms per square metre of heat surface per day. Distillation at pressures below atmospheric would not reduce the heat required per kilogram of water, but the efficiency of heat collection would be greater because of the lower temperature. Considerable improvements have been made recently by introducing black dyes into the solution to increase the proportion of the heat absorbed.

There is great scope for a combination of solar heater and thermal pump. This system would enable almost complete recovery of the latent heat of condensation and would greatly increase the output for a given size of plant.

Conclusions.—It appears therefore that, there is, at present, no way in which the use of solar

energy can make a large contribution to our sources of power. However, energy for domestic hot water heating can in favourable circumstances be obtained and there is scope in certain tropical areas for the distillation of water using a combination of solar heater and thermal pump. It is desirable that a cooking stove, utilizing solar energy and suitable for large-scale production, should be designed for use in a country like India. The development of air-conditioning equipment driven by solar power is worth consideration as is the design of a flat-plate collector for driving a small engine. Perhaps the most profitable way of utilizing solar energy is through the media of plants, and it would therefore be worthwhile to investigate the design of a small steam engine of high efficiency using wood or other plant material as fuel.

CENTRAL ELECTRO-CHEMICAL RESEARCH INSTITUTE, KARAIKUDI

THE Central Electro-Chemical Research Institute which was formally declared open by Dr. S. Radhakrishnan, Vice-President of India, on 14th January, 1953, is the tenth institution belonging to the network created by the Council of Scientific and Industrial Research, under the direction of Dr. S. S. Bhatnagar. Created for the rationalisation of industry, this network has been able to win the substantial support of Indian industrialists. The emergence of the Institute was largely made possible by the gesture of Dr. Alagappa Chettiar who offered a donation of Rs. 15 lakhs and a free gift of 300 acres of land for the Institute.

The Institute will have a number of major divisions dealing with electro-metallurgy and electric furnace products, electrolytic cells,

electro-deposition and allied processes, electro-chemistry of gases, etc. Besides the usual laboratory services and general chemical measuring instruments, etc., certain special work facilities and equipment such as liquid air plant, X-ray diffraction equipment, spectrographic and metallographic equipment, a constant temperature room, micro-analysis apparatus, electrolytic cells for special purposes—for fluorine for example—apparatus for repair and standardisation of precision instruments, are also intended to be provided. Provision has already been made for a general workshop, a lecture theatre and a well-equipped library. Space provision has also been made for accommodating a Museum or to be more appropriate, an Exhibition of products and equipment of interest to electro-chemists.

LADY TATA MEMORIAL TRUST SCIENTIFIC RESEARCH SCHOLARSHIPS, 1953-54

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1953-54 commencing from 1st July, 1953. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research Institute or Laboratory on

a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trustees. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay 1. The last date for receipt of applications is 15th March, 1953.

CHROMOSOMES AND THE SPECIES PROBLEM IN THE GENUS *VIBURNUM*

E. K. JANAKI AMMAL

Botanical Survey of India, Calcutta

IN 1914 *Viburnum fragrans*, the most beautiful of all winter flowering shrubs, was introduced into European gardens. Reginald Farrer² found it growing wild in the barren hills round Kai Chow in S. Kansu, North China. As a cultivated plant it had a long history in China judging from the fine old specimens Farrer described as growing in every temple and palace and hamlet in Kansu. It was a Royal flower in Peking and reached common hands only with the fall of the Imperial dynasty. Several varieties of this rose-coloured *Viburnum* have arisen in cultivation of which a white form is in the collection at Wisley. The plants introduced into England came from Jo-ni, a little Tibetan village on the foothills of the Min Sa Alps. In 1932, Simonet and Miedzyrzecki⁶ reported the chromosome number of *V. fragrans* as $x=8$; $2n=16$. This was a new basic number for the genus *Viburnum* in which Sax and Kribs⁵ had found only plants with $x=9$; $2n=18$. Yet a

third basic number $x=10$ was found by Sugiura⁷ in *V. odoratissimum* ($2n=40$) of China and India, an evergreen species, otherwise closely related to *V. fragrans*.

I had occasion to examine two garden hybrids of *Viburnum* and their parents in connection with their description for publication in the Botanical Magazine. The first was *V. Bodnantense*, a cross between the Himalayan species *V. grandiflora* and *V. fragrans* of Kansu. It had $2n=16$ chromosomes. I found that *V. grandiflora* had like *V. fragrans*, also $2n=16$ chromosomes. The chromosomes of the two species paired normally in the hybrid *V. Bodnantense*, pollen fertility being as high as 100 per cent. in this hybrid. The second hybrid I examined was *V. Juddii*, a cross between the Japanese species *V. bitchiuense*, and the closely related Korean species *V. Carlesii*. *V. bitchiuense* had $2n=16$ chromosomes and *V. Carlesii* $2n=20$, while the hybrid *V. Juddii* had

TABLE I

Chromosome numbers in species of *Viburnum*

| | | | |
|--------------------------------------------------------------------------|----------------------------------------|---------------------------|-------------------------------|
| I. With <i>Paniculate inflorescence</i> (Deciduous, rarely evergreen) | | | |
| Section THYRSOMA $x=8, 10$ | | | |
| | <i>2n</i> Distribution | | |
| <i>V. fetens</i> | 16 N.W. Himalayas, Kashmir | <i>V. Wrightii</i> | 16 Japan |
| <i>V. grandiflorum</i> | 16 Himalayas, Bhutan | <i>V. lobophyllum</i> | 18*, 20, 22 C. and W. China |
| <i>V. sibiridii</i> | 16 Japan | <i>V. acerfolium</i> | 18 N. America |
| <i>V. suspensum</i> | 16 Liukiu Islands | <i>V. betulifolium</i> | 18 C. and W. China |
| <i>V. fragrans</i> | 16 Kansu | <i>V. ovatifolium</i> | 18 W. China |
| var. <i>alba</i> | 32 Cult. Kansu | <i>V. dentatum</i> | 54 N. America |
| <i>V. Henryi</i> | 48 Hupeh, Szechuan, Yunnan | (Deciduous) | |
| <i>V. cumbosum</i> | 48 Szechuan, Hupeh, Nilgris, Himalayas | Section PSEUDOPULUS $x=9$ | |
| <i>V. odoratissimum</i> | 40 India, China | <i>V. tomentosum</i> | 18 China, Japan |
| | | var. <i>mariesii</i> | 18 Cult. |
| | | var. <i>sterile</i> | 18 Cult. |
| II. With <i>Umbellate inflorescence</i> (Deciduous and evergreen) | | Section OPULUS $x=9$ | |
| Section LANTANA $x=8, 9, 10$ | | <i>V. opulus</i> | 18 Europe, N. Africa, N. Asia |
| <i>V. bitchiuense</i> | 16 W. Japan | <i>V. Sargentii</i> * | 18 N.-E. Asia |
| <i>V. Mongolicum</i> | 16 E. Siberia, Kansu | <i>V. trilobum</i> | 13 N. America |
| <i>V. Carlesii</i> | 20 Korea | Section LENTAGO $x=9$ | |
| <i>V. betulifolium</i> | 20 C. China | <i>V. lentago</i> | 18 W.-N. America |
| <i>V. utile</i> | 18 C. China | <i>V. nudum</i> | 18 W.-N. America |
| <i>V. lantana</i> | 18 Europe, W. Asia | <i>V. prunifolium</i> | 18 W.-N. America |
| <i>V. rhytidophyllum</i> | 18 C. and W. China | Section PSEUDOTINUS $x=9$ | |
| (Deciduous, rarely evergreen) | | <i>V. alnifolium</i> | 18 N. America |
| Section ODONTOTINUS $x=8, 9, 10$ | | <i>V. furcatum</i> | 18 Japan |
| <i>V. fatidum</i> | 16 W. China | (Evergreen) | |
| var. <i>rectangulatum</i> | 16 Szechuan | Section TINUS $x=9$ | |
| | | <i>V. cinnamomifolium</i> | 18 W. China |
| | | <i>V. Davidi</i> | 18 W. China |
| | | <i>V. Tinus</i> | 36 S. E. Europe |

* Count by Sax

$2n=18$, the number reported by Sax for all the species of *Viburnum* he examined. Thus by artificial hybridization it has been possible to synthesize a plant with a basic number $x=9$, not only common in *Viburnum*, but dominant for many genera belonging to the family Caprifoliaceae.¹

A chromosome survey of *Viburnum* species grown at The Royal Horticultural Society Gardens, Wisley, Royal Botanic Gardens, Kew, and the Jardin de Plantes, Paris, was next undertaken to study the natural distribution of these three numbers, $x=8$, $x=9$, $x=10$ and to see what relationship, if any, existed between these numbers and the classification of the genus. The results are presented in Table I in which the species I studied are arranged under the 8 sections based on the classification of Rehder.⁴

There are about 120 species included in the genus *Viburnum*. These are distributed from the arctic regions of Alaska and Labrador down to the warmer regions of Central America, N. Africa and Asia as far as Java. Only three species are European while more than half the total number belong to Asia. Taxonomically, *Viburnum* species fall into two main classes—those in which the inflorescence is *paniculate* and those in which it is *umbellate*. The species with paniculate inflorescence—the THYROSOMA Section of Rehder to which belong *V. fragrans* and *V. grandiflora*, are exclusively Asian, being distributed from the Himalayas to Japan and N. Asia. They are predominantly

deciduous and often precociously flowering, the exceptions being *V. odoratissimum* and *V. suspensum*. The basic chromosome number of all the deciduous species of this group is $x=8$. Noteworthy is the fact that high polyploids occur in this section and they are found not only in the region of the Sino Himalayas—a region of high evolutionary activity in S.-E. Asia,³ but also on the isolated mountains of Peninsular India. Thus THYROSOMA evidently had once a wide and continuous distribution in the flora of Asia and is definitely a relic at the present time.

The white form of *V. fragrans* is the only tetraploid I found in this section and it probably arose in cultivation in China. The place of the evergreen *V. odoratissimum* with a “secondary” $x=10$ basic number, in this section, is explained, when we examine the cytological picture presented by the umbellate flowered LANTANA and ODONTOTINUS sections, where also deciduous and evergreen species are included (see Table). The presence of a few related species with $2n=20$ in areas of diploids ($2n=16$) can only mean that they have arisen from them and the genetic relationships of *V. bitchiuense* ($2n=16$) and *V. Carlesii* ($2n=20$) the two parents of *V. Juddii* ($2n=18$) can be explained if we consider *V. Carlesii* ($2n=20$) as having arisen as a backcross between a chance triploid ($2n=24$) of *V. bitchiuense* with the normal diploid ($2n=16$) form, as follows ($2n=24$) \times ($2n=16$) = ($2n=20$) (see Fig. 1):—

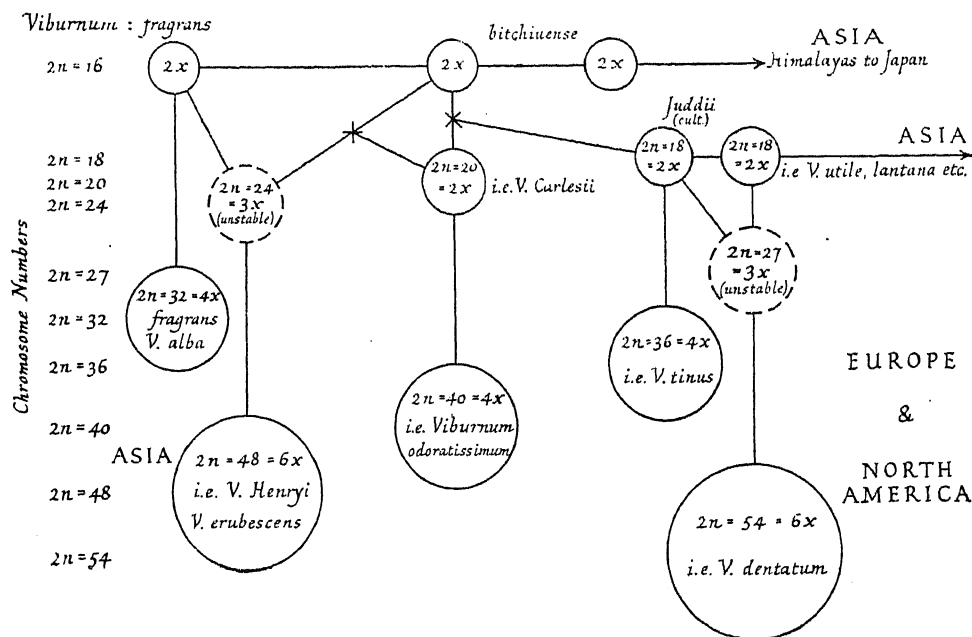


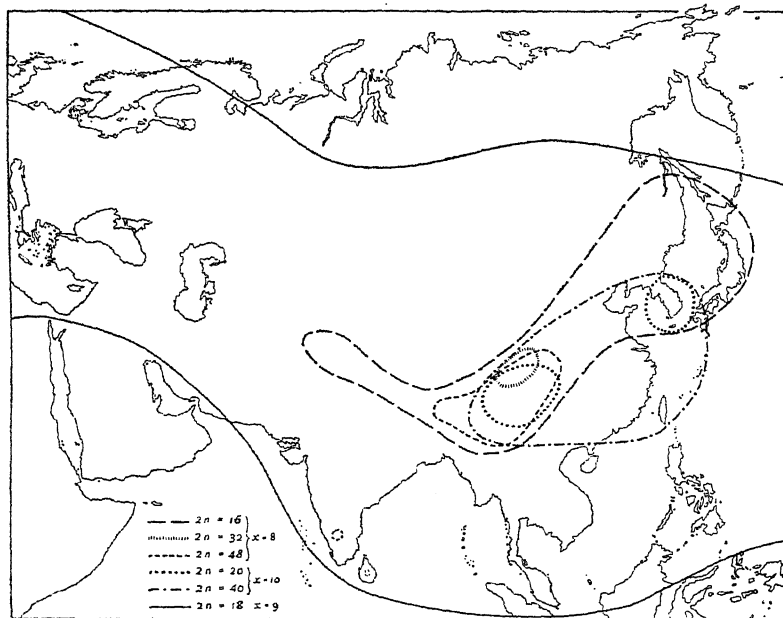
FIG. 1. Scheme of Chromosomes in *Viburnum*.

Triploids are commonly produced in nature and abundantly in cultivation. Their presence in a population of perennial woody plants as *Viburnum* can be a constant menace to the stability of diploids owing to the continued hybridization that can take place between them and diploids. They are a source of perennial contamination of extra chromosomes and thus become a cause of new directives in the evolution of the species. In *V. lobophyllum*, a species closely related to *V. Wrightii* ($2n=16$) three chromosomal forms were noted. The plant I

so far examined have only this "tertiary" basic number $x=9$. The highest polyploid I found in this section, the hexaploid *V. dentatum* ($2n=54$) is also N. American.

The evergreen *V. tinus* ($2n=36$) is the only "tertiary" polyploid *Viburnum* I found in the old world. It is one of the few species of *Viburnum* that survived the Ice Age in Europe. It is very likely that varieties of this species with larger flowers which are known in cultivation will be found to be even higher polyploids.

In the accompanying Map, I have shown the



DISTRIBUTION OF POLYPLOID VIBURNUMS IN ASIA

FIG. 2.

examined had $2n=20$ like *V. Carlesii*, while a plant of *V. lobophyllum* from Exbury was found to have $2n=22$ by Enoch (unpublished). (This number is the dominant one for the family Rubiaceae, most closely related to Caprifoliaceae.) The plant studied by Sax had $2n=18$. Thus we can say that what happened in the garden in the production of *V. Juddii* ($2n=18$) has also been happening in nature in the evolution of species in *Viburnum*. This has finally resulted in a stable population of a large number of species with the "tertiary" basic number $x=9$ commonly found in the family Caprifoliaceae.

All the species included in sections PSEUDOPULUS, OPULUS, LENTAGO and PSEUDOTINUS by the botanist are "tertiary" diploids ($2n=18$). They are found widely distributed in both the old and new world. It is a significantly remarkable fact that all the American *Viburnums*

distribution of diploid and polyploid species of *Viburnum* in Asia. The significance of the Sino-Himalayas as a region of a high evolutionary activity in species of *Viburnum* in Asia is shown by the distribution of high polyploids in that area.

The diagrammatic scheme (Fig. 1), explains the relationship between chromosome numbers and the origin of species in the genus *Viburnum*.

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STUDIES IN ANCIENT INDIAN MATERIALS AND INDUSTRIES

A Pottery Glaze of Kushana Period from Khokrakot Mound

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INTRODUCTION

IN connection with the studies initiated in this laboratory on ancient Indian materials and industries belonging to proto-historic and historic periods, a glazed pot-herd from Khokrakot mound* in Rohtak District was found to be of much interest as it provided an authentic specimen of glaze of the Kushana period (1st-3rd centuries). As the author is not aware of any published data on Indian glaze samples of comparable age, it was thought desirable to carry out a complete chemical analysis of the sample in order to determine its composition and the technique of colouring.

Incidentally it may be remarked that Khokrakot has yielded a vast collection of ancient coin moulds and other important archæological material which have thrown a flood of light on coining technique in ancient India.³

EXPERIMENTAL

The glazed sherd has a chocolate-brown body and represents part of a coarse thick ware, the concave surface of which carries a layer of dirty brownish green glaze of 0.5 to 1 mm. thickness. The glaze shows crackle but is adhering very firmly to the surface of the sherd. For the preparation of a sample for chemical analysis the glaze was chipped off the body very carefully and traces of the body material adhering to the glaze were removed before powdering the sample for quantitative estimation. It had the following percentage composition: SiO_2 , 61.76; Fe_2O_3 , 5.07; FeO , 0.82; Al_2O_3 , 14.77; MnO , 0.04; CaO , 2.29; MgO , 2.13; Na_2O , 9.73 and K_2O , 4.12. Total, 100.73.

The chemical analysis shows that it is not a phosphate glaze and it is free from lead and

barium. Early Egyptian⁴ and other Middle Eastern glazes are also free from barium and phosphate, the addition of which is a later development in the technique of glass making and glazing. Ancient Chinese glasses (550 B.C.) have been found to contain both barium oxide and lead oxide.⁵ The present specimen, therefore, represents an ordinary soda-lime glaze containing an appreciable amount of potash and a very high proportion of alumina. Addition of alumina prevents devitrification of glass, and produces a harder, durable, and more elastic glass.^{6,7} Alumina in excess of 4%, however, is not a desirable constituent of glass of excellent working quality, and the amount of 14.77% found in this sample is, therefore, unusually high. The colour of this glaze is due to iron oxides.

As the manufacture of glass is not far removed from that of glaze, and since chemically there is no difference between the two, it is interesting to compare the chemical composition of this glaze with the composition of earlier glass specimens of 4th-3rd century B.C., i.e., the glass specimens unearthed at Taxila. From published analyses of Taxila glasses,⁸ it is seen that no glass from Taxila shows such a high alumina content. In other respects, its composition is similar to that of Taxila glass. The alkalis are present to the extent of 13.85%, but the alkaline earths, lime and magnesia, account for only 5.42% of the sample. If the oxides, R_2O_3 are added to silica, it is seen that 81.60% of acidic oxides are present.

In the absence of chemical data on the composition of glazes of Kushana period from other sites, it is not possible to make a comparative general study of the glaze industry of this age. Recently some glazed pot-herds have been found by the author from the glass factory site of Kopia, which has been dated tentatively by Nagar⁹ to circa 5th century B.C., on stylistic grounds. Although no age value should be attached to such surface finds, it is likely that these glazed sherds might be assignable to Kushana times, i.e., 1st-3rd centuries. The chemical examination of these specimens is likely to throw much light on the technique and composition of glazes of this period, and on the

* There is a series of mounds covering an extensive area in the immediate outskirts of the modern city of Rohtak (Long. $76^{\circ}35'$ E.; Lat. $28^{\circ}54'$ N.) in the East Punjab. One of these mounds, in the immediate neighbourhood of the city, has long been preserved as a protected monument by the Archaeological Survey of India,¹ and is known as Khokrakot mound. Rao Bahadur K. N. Dikshit,² late Director-General of Archæology in India, has concluded from an examination of the surface finds that Khokrakot was in occupation upto the Kushana period.

question of the development of the glaze industry from 4th-3rd century B.C., to 2nd-3rd century A.D. This work is in progress.

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RAPTAKOS MEDICAL FELLOWSHIP AWARDS

THE Raptakos Medical Research Board Fellowships for the year 1953 have been awarded to the following candidates for research work in subjects mentioned against their respective names:—Mr. D. V. Rega, University Department of Chemical Technology, Bombay—Role of Folic acid and vitamin B₁₂ in nucleic acid metabolism; Mr. M. Bhimasena Rao, Indian Dairy Research Institute, Bangalore—Milk diets in relation to

Infantile Cirrhosis; Mrs. Shanta Savur Srinivas Rao, Haffkine Institute, Parel, Bombay 12—Iso-lation and the study of biological properties of the therapeutically important constituents of the Cobra and Russell's Viper venom; Dr. Shyam Kumar Vaish, Indian Veterinary Research Institute, Izatnagar—Diet and its relation to blood and tissues electrolytes.

CENTRAL LEATHER RESEARCH INSTITUTE, MADRAS

THE Central Leather Research Institute, which was inaugurated by Shri T. T. Krishnamachari, Central Minister for Commerce and Industry, on 15th January 1952, is the result of co-operation by many interests. The Government of Madras made a gift of nearly 84 acres of land in the Guindy area and also bore the cost of procuring and reclaiming it. The leather industry has made so far contributions amounting to nearly Rs. 1.21 lakhs and further support is expected. Rs. 35.5 lakhs has been sanctioned for buildings and equipments and the annual recurring cost is expected to be Rs. 3.5 lakhs.

Research, training and dissemination of technical knowledge to the leather industry are the three-fold function of the Institute. Research in the Institute can be classified into three broad categories. The first is fundamental work comprising research on the histology of hides and skins, physical structure and properties of hide and skin fibres, chemical constitution of hide and skin proteins. Next comes applied work including research on the application of chemistry, physics, bacteriology, microscopy and other branches of science in tanning and production of leather, control processes including study of the mechanism of vegetable tannins, mineral tanning agents, discovery of new tan-

ning agents, tanning auxiliaries and tanning processes. Lastly, there is development research implying investigations on processes of tanning and manufacture of leather auxiliaries practised in western countries to adapt them to Indian raw materials and conditions, pilot plant and extra-mural demonstrations of processes to industrial concerns, trials of new tanning auxiliaries and testing their performance in actual industrial manufacture.

The model tannery of the Institute has been equipped with a complete set of tanning machinery so that researches on leather manufacture may be carried up to a semi-commercial scale and trainees can get the advantages of working with intimate knowledge of demand conditions, production problems and consumer acceptance.

The Institute will form the nucleus for the dissemination of technical education to Indian leather industry including the issue of technical bulletins, contributions of articles to scientific and leather trade journals and answering of technical enquiries, etc. This work has already been started and a technical bulletin is being issued monthly. Technical enquiries received from different parts of India are also being replied to.

BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY

THE opening ceremony of the new building of the Birbal Sahni Institute of Palaeobotany at Lucknow on 2nd January by the Prime Minister of India is the culmination of a fond dream of its founder, who did not live to see the fulfilment of his dream. The idea of creating a palaeobotanical institute has been in Professor Sahni's mind from as early as 1930, but could not be put into concrete shape because of the lack of financial support. However, in 1946 he resolved, together with his wife, Mrs. Savithri Sahni, to bring these plans to realisation and to begin on a small scale and with private resources.

In September 1948, the institute received the gift of an estate adjoining the University of Lucknow from the U.P. Government and also financial assistance from both this Government and the Government of India. Plans were laid for erecting a new modern building for the Institute, and its foundation-stone was laid by Pandit Jawaharlal Nehru on 3rd April 1949. Within a week after this function, the Institute suffered the heaviest loss that could befall it—Professor Sahni breathed his last on 10th April. However, by the efforts and untiring work of Mrs. Sahni, the co-operation and support of Professor Sahni's pupils and collaborators and the sympathetic interest taken by the Central

Government and in particular by Dr. S. S. Bhatnagar, the Institute continued to work and prosper and with the opening of the new buildings, the Institute can be said to have tided over its critical period.

Declaring the Institute open, Pandit Nehru paid glowing tributes to the late Professor Sahni, and mentioned that Professor Sahni was not only an internationally recognized expert in his own field, but also a leading personality in the scientific life of India. He expressed the hope that the Institute would fulfil the ambition of Professor Sahni of establishing an International Centre of Research in Palaeobotany in India.

This Institute is unique in the whole world, in that it is the only one which is devoted solely to investigations on palaeobotany. The present Director is Dr. O. A. Höeg, former Professor of Botany, University of Oslo, Norway, who joined the Institute in 1951. In addition to the laboratories, the Institute houses its own library consisting principally of Professor Sahni's collection of journals and reprints. There is an excellent museum exhibiting the various sides of palaeobotany, what fossil plants are, how they are preserved and how their study is applied for obtaining a geological time table. We wish the Institute all success in its activities.

NEW FIELDS OPENED UP IN ELECTRONICS

A NEW device called 'transistor' will make possible in the near future improved new-type radios, telephone apparatus and other types of electronic equipment that now use vacuum or electron tubes.

The transistor, which was developed by the Bell Telephone Laboratories in the United States, does the same kind of electrical work as a vacuum tube. The transistor consists of a tiny piece of germanium connected to wires and imbedded in a piece of plastic about the size of a pea. In this particle of germanium electrons do the same type of work that they do in a vacuum tube. It is believed that transistors will soon be used in tiny radios no bigger than a

watch that will operate indefinitely on one set of batteries, in telephones with built-in amplifiers, and in television sets whose tubes may not need renewal.

Several thousand transistors can be operated on the power needed for a single vacuum tube. Other advantages of the transistor are that they do not generate intense heat when in operation, as do vacuum tubes, and that they will last indefinitely. Most vacuum tubes have a life of only a few thousand hours. Transistors that are probably capable of operating continuously for more than 100,000 hours have already been made in the laboratory.

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REMARKS ON THE CONSISTENCY EQUATIONS OF FINITE STRAIN

SETH¹ proved that if s_{ij} are the components of finite strain, then the consistency conditions reduce to the vanishing of Riemann-Christoffel tensors formed from the metric

$$g_{ij} = \delta_{ij} - (1 + \delta_{ij}) s_{ij} \quad (1)$$

i.e.,

$$R_{ikl}^n \equiv \frac{\partial}{\partial x_k} \left\{ \frac{n}{li} \right\} - \frac{\partial}{\partial x_i} \left\{ \frac{n}{lk} \right\} + \left\{ \frac{n}{si} \right\} \left\{ \frac{s}{lk} \right\} + \left\{ \frac{n}{sk} \right\} \left\{ \frac{s}{li} \right\} = 0 \quad (2)$$

$\left\{ \frac{n}{li} \right\}$ being the usual affinity given by

$$\left\{ \frac{n}{li} \right\} = \frac{1}{2} g^{ns} \left(\frac{\partial g_{is}}{\partial x_l} + \frac{\partial g_{li}}{\partial x_s} - \frac{\partial g_{ls}}{\partial x_i} \right) \quad (3)$$

Several other authors,² have also obtained such results.

This result brings to light the following facts of theoretical interest:

(1) Since in three dimensions the number of contracted and uncontracted Riemann-Christoffel tensors are the same and further as they are connected by linear relations it follows that the vanishing of the contracted Riemann-Christoffel tensor can equivalently be taken as the consistency equations. Now, remembering that the field equations in the gravitational theory of relativity are the contracted Riemann-Christoffel tensors equated to zero it follows that the consistency conditions are the three dimensional analogue of the field equations in relativity.

(2) Since the Riemann-Christoffel tensors follow the Bianchi identities, the consistency conditions are related to one another by the relations

$$R_{kls; i}^n + R_{kls; i}^n + R_{kls; i}^n \quad (4)$$

where semi-colon (;) denotes covariant differentiation.

As a first approximation we have

$$\frac{\partial E_{yz}}{\partial x} + \frac{\partial E_{xz}}{\partial y} + \frac{\partial E_{yy}}{\partial z} = 0, \text{ etc.} \quad (5)$$

where

$$\left. \begin{aligned} E_{xx} &= \frac{\partial^2 \rho_{xx}}{\partial y \partial z} + \frac{\partial^2 \rho_{yz}}{\partial x^2} - \frac{\partial^2 \rho_{zy}}{\partial x \partial y} - \frac{\partial^2 \rho_{xy}}{\partial x \partial z} \\ E_{xy} &= 2 \frac{\partial^2 \rho_{xy}}{\partial x \partial y} - \frac{\partial^2 \rho}{\partial y^2} - \frac{\partial^2 \rho_{yy}}{\partial x^2} \end{aligned} \right\} \quad (6)$$

(ρ 's being the components of strain)

The identities (5) hold independent of the fact that

$$E_{xx} = 0, E_{xy} = 0, \text{ etc.}$$

which form the consistency equations of the small strain theory.

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Kharagpur,

November 19, 1952.

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2. *Math. Rev.*, 1951, **12**, 555, where a full list is given.
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IMPROVEMENT OF CORNU'S METHOD FOR DETERMINING ELASTIC CONSTANTS

IN the so-called Cornu's method for the determination of the elastic constants of transparent substances, the theory holds only for a plane beam, while in practice we are confronted with beams which are not plane. In the present note methods are suggested to eliminate the errors due to the curvature of the beam. The very small effect of the weights of the beam and the hangers, on bending, has been neglected.

Consider a beam having initial longitudinal and transverse radii of curvature R_0 and r_0 , and let these be altered to R and r when a bending moment G is applied to it. Then we have the following relations¹:

$$G = YAk^2 (1/R - 1/R_0) \quad (1)$$

$$\sigma = (1/r - 1/r_0)/(1/R - 1/R_0), \quad (2)$$

where the symbols have their usual meanings.

The two radii of curvature (R and r) can be measured by forming interference fringes² between the horizontal surface of the beam and a test plate.

Young's modulus can be calculated by eliminating the initial curvature from the equations by either of the following two methods: (i) If R_1 and R_2 be the two longitudinal radii of curvature when bending couples G_1 and G_2 are applied to the beam, then we have from equation (1)

$$G_1 - G_2 = YAk^2 (1/R_1 - 1/R_2) \quad (3)$$

(ii) Let R_1' be the longitudinal radius of curvature with a bending couple G and R_2' be its value with the same couple when the beam is reversed (initial curvatures change sign). Then, we have

$$2G = YAk^2 (1/R_1' + 1/R_2') \quad (4)$$

The equations for the Poisson's ratio under the same conditions are:

$$(i) \sigma = (1/r_1 - 1/r_2)/(1/R_1 - 1/R_2) \quad (5)$$

$$(ii) \sigma = \frac{(1/r_1' + 1/r_2')}{(1/R_1' + 1/R_2')} \quad (6)$$

For considerable improvement in the sharpness of the fringes the authors suggest that the beam and the test plate should be silvered (reflecting coefficient about .95) and the fringes be viewed or photographed in transmission.

The authors acknowledge their thanks to Dr. K. Majumdar for his interest in the investigation.

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Allahabad University, YATENDRA PAL VARSHNI.
Allahabad,
September 16, 1952.

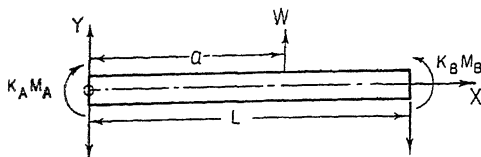
1. Morley, *Strength of Materials* (Longmans, Green & Co., London, Toronto and New York), 1940, p. 405. 2. Newman and Searle, *The General Properties of Matter* (Edward Arnold Co., London), 1949, p. 119.

PARTIALLY FIXED BEAMS

THE so-called fixed beams are actually only partially fixed at their ends. In several cases it may be possible to assume ideal fixity and proceed with the design without making any appreciable error. However, in other cases when the fixities are far from ideal, it is essential to take the partial fixities into account, if the accurate analysis and design are needed.

Recently, Lothers¹ obtained elastic restraint equations for semi-rigid connections of specific types. The following method is more general and can be applied in general to any type of end fixity.

The coefficient of end fixity can be defined as the ratio of actual bending moment at a partially fixed end to the bending moment at the same end in case of ideal fixity. As an example, with 0.8 and 0.9 as the coefficients of end fixity at the left and right ends respectively and load at 0.6 span we find that the bending moment under the load is increased by over 14% compared to calculations made assuming ideal fixity, although the corresponding increase for shear is less than 1%.



In the above figure K_A and K_B are the partial end fixity coefficients ($0 \leq K_A \leq 1$, $0 \leq K_B \leq 1$) and M_A and M_B are the end moments when the beam is rigidly fixed. The beam is assumed to be of a uniform cross-section. Then the bending moment under the load M_w , the shear just to the left of the load S_L , the shear just to the right of the load S_R and deflection under the load Y_w are given by,

$$M_w = K_A M_A - \frac{(K_B M_B - K_A M_A) a}{L} - \frac{W a (L - a)}{L} \quad (1)$$

$$S_L = \frac{K_B M_B - K_A M_A}{L} - \frac{(L - a) W}{L} \quad (2)$$

$$S_R = \frac{K_B M_B - K_A M_A}{L} + \frac{a W}{L} \quad (3)$$

$$Y_w = \frac{a}{L E I} K_A M_A \left(\frac{a L}{2} - \frac{a^2}{6} - \frac{L^2}{3} \right) - K_B M_B \left(\frac{a^2}{6} - \frac{L^2}{6} \right) + \frac{W (L - a)}{3} (L a - a^2) \quad (4)$$

where E is Young's Modulus for the material of the beam and I is the moment of inertia about the neutral axis of the cross-section of the beam.

$$\text{Since } M_A = \frac{W a (L - a)^2}{L^2} \text{ and } M_B = \frac{W a^2 (L - a)}{L^2}$$

it is evident that M_w , S_L and Y_w are functions of three variables, namely, K_A , K_B and a/L , if W is considered as a unit load. Hence nomograms can be constructed with K_A , K_B and a/L as independent variables and M_w , S_L , S_R and Y_w can be read off these nomograms for any given set of values of K_A , K_B and a/L .

These nomograms can be used to determine the actual coefficients of end fixity of any given beam, as solution of two simultaneous equations in K_A and K_B will in general lead us to the specific values of K_A and K_B for the beam under consideration.

In practice, we can accurately measure the normal stresses due to bending by means of electrical strain gauges. For a given load W acting at a known point a/L , the normal stress measured under the load gives us the value of bending moment M_w ; in other words, one equation in K_A and K_B . Similarly, the second equation can be got with load at some other point and these two equations can be solved for K_A

and K_B . Alternately, two deflection experiments or one bending stress measurement and another deflection measurement will give us the required equations to solve for K_A and K_B . Once the end fixities are known, either the equations (1), (2), (3), (4) or the nomograms can be used for an accurate design.

The authors wish to thank Prof. O. G. Tietjens for his suggestions and for his permission to publish this note.

Dept. of Aeronautical Engg., C. V. JOGA RAO.
Indian Inst. of Science, J. V. RATTAYYA.
Bangalore,
December 1, 1952.

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ON THE OCCURRENCE OF *SIDEROLITES* SP. AND *GLOBOTRUNCANA* cf. *ARCA* FROM THE UPPER CRETACEOUS OF PONDICHERRY, SOUTH INDIA

Fossils from Pondicherry have been studied by Forbes, E.,¹ d'Orbigny, A., Blanford, H. F.,² Stoliczka, F.,³ Warth, H.,⁴ and Kossmat, F.⁵

Kossmat,⁶ in 1897, after a detailed study of the stratigraphy and palaeontology of the cretaceous deposits, divided them into three main divisions, the lowermost Anisoceras beds (Valudayur beds) overlain successively by the Trigonarca beds and Nerinea beds. The uppermost he referred to the Danian and the two lower ones to Upper Senonian.

During a recent visit to this area the author made a collection of the fossils of Upper Cretaceous and Eocene beds. The occurrence of *Siderolites* sp. (Fig. 1) and *Globotruncana* cf.

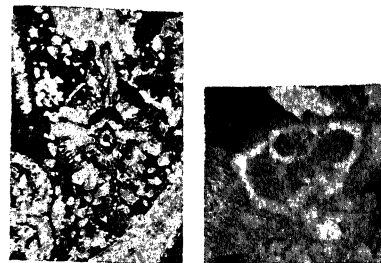


FIG. 1. *Siderolites* sp., $\times 13$. FIG. 2. *Globotruncana* cf. *arca*, $\times 80$

arca (Fig. 2) was noted in thin sections of the rock from the Upper Cretaceous beds. The rock is a hard, fine-grained, calcareous sand-

stone with shells of gastropods and bivalves. It is of bluish brownish colour and is referable to the Anisoceras beds (Valudayur beds) of Kossmat.

This is the first report of these genera from the Upper Cretaceous of Pondicherry. Except for an undescribed species of *Siderolites* from the Trichinopoly area reported by Rao,⁷ this genus has not hitherto been recorded from the Indian region.

A detailed description of these species will be published elsewhere.

I am highly indebted to Prof. S. R. Narayana Rao for his guidance.

Dept. of Geology, Lucknow University,
Lucknow,
August 18, 1952.

R. S. SHARMA.

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A PRELIMINARY NOTE ON THE MIOCENE BEDS OF KATHIAWAR, WESTERN INDIA

SINCE the pioneer work of Fedden¹ in 1884, little has been added to our knowledge of the Tertiary geology of Kathiawar. We visited Kathiawar in February, 1952, and mapped the area around Bhogat (69° 14' : 21° 59') and Bhatia (69° 16' : 22° 6') in western Kathiawar and made a palaeontological collection from the beds occurring there. A preliminary investigation has revealed that the beds occurring in this region which Fedden described as Gaj, consist of two formations: an upper one which is post-Gaj in age and a lower one which is Burdigalian in age and may be the equivalent of the upper Gaj of Sind.

The fossiliferous rocks are confined to a narrow belt of 7 to 10 miles along the coast. The outcrops are met in creeks and nullahs. The beds show a very gentle dip up to 7° towards the coast. The sequence of rocks met with is as follows:—

5. Dwarka beds of Fedden. White shaly limestones with fragments of shells and corals, found on the cliffs near the coast. Age: Post-Pliocene.

4. *Orbiculina*-bearing beds of Bhogat. Buff-coloured argillaceous limestones crowded with foraminifers among which the following occur: *Orbiculina malabarica*, *Tryblilepidina* sp., *Miogypsina* sp., *Austrotrillina howchini* and *Gypsina globulus*. Some calcareous algæ also occur. Age: Vindobonian.
3. *Miogypsina*-beds of Bhatia. Hard brownish limestones weathering red and crowded with tests of foraminifers. *Miogypsina* sp., *Miogypsinoides* sp., and *Austrotrillina howchini* are present. No *Lepidocyclines* were noticed here. Some calcareous algæ are also present. Age: Burdigalian.
2. Laterite beds.
1. Deccan traps.



Lepidocyclina (Tryblilepidina) sp. Equatorial section showing stellate test and the embryonic apparatus with the nepionic chambers. Loc. Bhogat, × 22.

Foraminiferal limestones of bed No. 4 and 3 were described by Fedden as Gaj beds. The foraminifers of the bed No. 4 indicate that it is Vindobonian in age and therefore a post-Gaj formation. Bed No. 3 is Burdigalian and probably the equivalent of upper Gaj.

Carter² in 1857 recorded *Orbiculina malabarica* from Kathiawar. The subgenus *Tryblilepidina* which characterizes bed No. 4 is being recorded here for the first time in India. It is a well-known Indo-Pacific form. This subgenus which resembles *Nephrolepidina*, is restricted to Vindobonian (Glæssner³). It is characterized by a stellate test and by the presence of nepionic chambers.^{4,5,6,7} *Nephrolepidina* is not found in these beds. The faunal assemblage as a whole shows a close affinity to that of the Indo-Pacific region.

Bed No. 3 differs from the above in faunal contents as well as in lithology. The absence of *Tryblilepidina* sp. and *Orbiculina malabarica* and presence of *Miogypsinoidea* sp. and *Miogypsina* sp., indicates that the bed cannot be younger than Burdigalian.

Eames⁸ has recently stated that Middle Miocene beds are absent in Western India. The present discovery of *Tryblilepidina* from Kathiawar proves the presence of Vindobonian (Middle Miocene) beds here.

Detailed work is in progress and results will be published elsewhere.

We are grateful to Prof. S. R. Narayana Rao for his guidance and encouragement.

| | |
|------------------------|------------------|
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| September 3, 1952. | V. V. RAO. |

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MONTICELLITE FROM THE CRYSTALLINE LIMESTONES OF BORRA, VISAKHAPATNAM DISTRICT

AROUND Borra (18° 17'–83° 03') in the agency tracts of Visakhapatnam District occur bands of crystalline limestone associated with khondalites. The village has come into prominence on account of the beautiful caves and caverns which are found in its environs and which contain impressive stalactites and stalagmites.

In connection with a systematic geological investigation of the area, various samples of crystalline limestone and marble were collected. While most of them are whitish, others exhibit various shades of light grey, very faint greyish green, dark grey and bluish grey colours. In some of the whitish varieties, there occur as disseminations slender prismatic crystals or oval grains, colourless to grey and bluish grey in colour and varying in length from a fraction of a centimetre to nearly one-and-a-half centimetres. The crystals are translucent to transparent with a vitreous lustre and breaking into bits nearly perpendicular to the length. The mineral has the crystal form of an olivine and has a hardness of about 5 and specific gravity of about 3.

In thin section, the crystalline limestone is mostly made up of calcite and dolomite and has in addition some monticellite and a few specks of sphene. Monticellite is colourless and has the characteristic outline of an olivine, elongated parallel to *c* (Fig. 1).



FIG. 1. Monticellite Crystals in Marble, $\times 18$.

The crystals are generally cracked. The relief of the mineral is high but the birefringence is rather low for the common olivine. In some cases, there is alteration along the margins and cracks to colourless serpentine. A few small slender acicular crystals are found as inclusions in the mineral and they appear particularly conspicuous under crossed nicols. While most of them are colourless, a few have a very faint bluish tint. The mineral which forms these crystals has a high birefringence and an oblique extinction and in all probability is tremolite.

The microscopic characters of the monticellite as determined with Federov's Universal Stage are recorded below:

Optically negative, biaxial with a large optic axial angle (2V) of $76^\circ \pm 1.0^\circ$, optic axial plane being parallel to (001). The birefringence (as measured with Berek's compensator) is 0.013.

The mineral is thus different from the common olivine which is mostly green in colour and has a higher birefringence.

Though Fermor^{1,2} has described forsterite from the marbles of Sausar Series, this is the first reported occurrence of monticellite-marbles

in the Archæans of South India. The occurrence of monticellite, a calcium magnesium orthosilicate, in the crystalline limestones and marbles, indicates that the original sediments were silica-poor, a fact confirmed by the paucity of silicate minerals in them.

A detailed study of the granular limestones and marbles is in progress and will be published elsewhere.

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November 7, 1952.

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INTERFACIAL SURFACE TENSION AND COMPLEX FORMATION IN SALT SOLUTIONS

NAYAR AND CO-WORKERS^{1,2} have shown the formation of complexes in various systems, such as $\text{Pb}(\text{NO}_3)_2\text{-KNO}_3\text{-H}_2\text{O}$, by the presence of anomalous values of physical properties at concentrations corresponding to their formation. Similar peaks are also found in the curves obtained by plotting interfacial tension of liquids having unstable H-bond ring structure against the concentration of any one variant. Using the drop number method,³ the authors have found peaks in the surface tension-concentration curve with the system $\text{CdI}_2\text{-KI-H}_2\text{O}$, corresponding to the complexes $\text{CdI}_2\cdot 2\text{KI}$ and $\text{CdI}_2\cdot \text{KI}$. Further, seven complexes in case of the system $\text{HgCl}_2\text{-KCl-H}_2\text{O}$, seven in $\text{HgBr}_2\text{-KBr-H}_2\text{O}$ and three in case of the system $\text{Pb}(\text{NO}_3)_2\text{-NaNO}_3\text{-H}_2\text{O}$ seem to be formed. In other cases, the results of Nayar, *et al.*, are confirmed. Auto-complex formation in case of salts like cadmium iodide, cupric chloride, etc., is evident from the results of such interfacial tension measurements. Experimental details of the study of all these systems with full discussion of the theory of reversal of electrical double layer at interface of liquids, referred to, will be published elsewhere.

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Surat,
October 1, 1952.

ROLE OF MANGANESE IN THE BIOSYNTHESIS OF ASCORBIC ACID

FURTHER evidence of the intermediary role of manganese in the biosynthesis of ascorbic acid (Rudra¹⁻⁵) has been obtained.

The increased synthesis of indophenol reducing substance by seedlings in suitable concentrations of manganese has been identified with true ascorbic acid by the biological method of Coward and Kassner.⁶ Other elements in similar concentrations are ineffective. That the increased synthesis, in presence of manganese, is not due to any protective action of the element on ascorbic acid has been found by following through its behaviour under identical conditions. In presence of manganese, the synthesised ascorbic acid consists of an increased amount of dehydroascorbic acid owing to the activation of ascorbic acid oxidase by manganese.

Signs resembling scurvy in guineapigs have been produced in rats and rabbits by putting them on a synthetic diet complete in other known essential principles but lacking in manganese. The signs became evident in the rat after 4 weeks and in the rabbit after 2 weeks on the diet. In addition to poor growth, scorbutic signs were evident not only by the much lowered contents of the vitamin (more or less of the same order as in guineapigs on scorbutic diet for an equal period) in the tissues but also by the histology of the tissues which have lesions resembling the lesions in scorbutic guineapigs reported by Hjärre and Lilleengen.⁷ These lesions produced in the first generation of manganese deficient animals cannot be confused with the lesions found by Pappenheimer⁸ in 20 per cent. of his vitamin E deficient mice who themselves were offsprings of parents who were deficient in vitamin E for 2 to 7 generations.

Young rabbits are extremely susceptible to manganese deficiency and many succumb within 2 weeks. High doses of manganese are toxic to animals as to plants. The enzyme isolated from *P. mungo* and rat jejunum⁹ is totally inhibited by 60 p.p.m. of manganese in the undialysed extract and almost inhibited by a similar concentration in the dialysed extract. Growth of rats is retarded by a not too high manganese diet which is also not relished by the animals like a too salty diet. The inability of Boyer, *et al.*,¹⁰ to demonstrate the synthesis of ascorbic acid was due to the high manganese content of the diet of supplemented rats. The histology of the lower incisors of manganese deficient and supplemented rats and rabbits are similar to the histology of vitamin C deficient and

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supplemented guineapigs respectively. Judging by the Key and Elphick¹¹ standard guineapigs on scorbutic diet given injections of manganese with glucose have about the same degree of protection as animals given 0.5 mg. vitamin C daily. Guineapigs on scorbutic diet given manganese injections with glucose have a phosphatase distribution (Gomori's technique¹²) in the adrenal, jejunum and liver of the same order as in normal animals getting vitamin C whereas the phosphatase distribution in the corresponding tissues of scorbutic animals is lessened.

The non-synthesis of ascorbic acid in manganese deficient animals is not due to arrest of growth. Arresting growth by restricting calories intake does not interfere with ascorbic acid synthesis. Hopkins and Slater¹³ also demonstrated synthesis in fasting animals.

The present evidence does not militate against the observation of others on the role of B vitamins in ascorbic acid synthesis. The possibility is not remote that the co-enzymes of the oxydase systems contain some of the well-known B vitamins and manganese.

The author is indebted to Prof. R. A. Peters for hospitality in the Department of Biochemistry, University of Oxford, where part of this investigation was carried out. He is also grateful to Mr. E. Leach of the Department of Physiology and Dr. A. Robb-smith of the Radcliffe Infirmary, University of Oxford, for histological sections and criticism.

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July 30, 1952.

M. N. RUDRA.

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CARBOHYDRATES OF AGAVE VERA CRUZ

It was reported previously from these laboratories that the surface underwood of *Agave vera Cruz* is a rich source of polyfructosans.¹ In the preparation of fructose* from this source, the raw material had to be subjected to several

treatments, essentially to free it from unwanted constituents, notably phenolic bodies and foam-forming substances. Even so, the resulting polyfructosan-rich material contained other water-soluble carbohydrates, among which evidence for the presence only of glucose and sucrose could be obtained by the traditional methods of sugar analysis. However, with the aid of paper partition chromatography, the underwood of *Agave vera Cruz* has now been shown to contain at least seven water-soluble carbohydrates.

Among the different techniques, the capillary ascent method gave the best results. Using filter-paper (Whatman No. 1; 40 cm. \times 40 cm.), butanol: acetic acid: water (4:1:5), about 60 hours for developing and then spraying with benzidine-trichloroacetic acid, a repeatable chromatogram, typical of Fig. 1, was obtained.

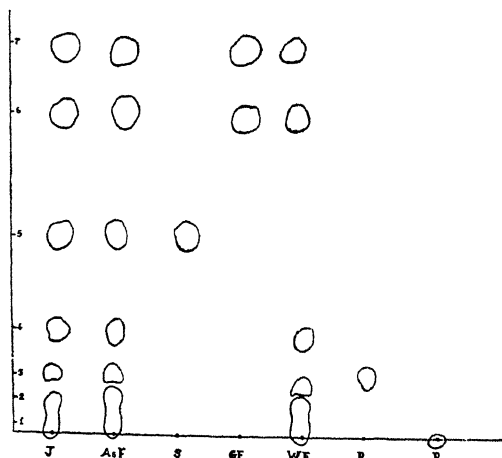


FIG. 1. Chromatogram of the Carbohydrates in *Agave vera Cruz*.

The test spots consisted of: The press juice (J); Polyfructosan precipitated from the press juice by stepwise treatment with ethanol upto 80% concentration (v/v) (P); Alcohol-soluble fraction, after removing the polyfructosan as above (A.F.); Water-extract of the grated and dried material (WE); Reference spots: Sucrose (S); Glucose fructose mixture (GF); Raffinose (R).

It is clear that the material contains a polyfructosan (Spot 1), 3 other carbohydrates (spots 2 to 4), sucrose (spot 5), glucose (spot 6) and fructose (spot 7). From the optical density (visual) of the spots, it is confirmed that the polyfructosan (P) is the major constituent. Spot 2 and spot 3, just below the position of raffinose (R) and spot 4 just above it are yet to be identified. However, on spraying a guide strip with phloroglucinol-trichloroacetic acid reagent, spots 2, 3 and 4 in common with spot 1

(and of course sucrose and fructose spots) showed up, indicating the presence of easily hydrolysable ketose residues in the carbohydrates corresponding to these spots. It will also be noticed that polyfructosan spot P has not been resolved by the developing solvent, confirming the homogeneity of this polyfructosan, as shown also by its chemical characteristics, details of which will be published elsewhere.

Our thanks are due to Dr. V. Subrahmanyan for his kind interest in the work.

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November 4, 1952.

* Patent under application.

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ROOT DEVELOPMENT IN *LENS ESCULENTA* MOENCH

WITH a view to find out the depth of cultivation and spacing necessary for sowing this crop, work on root development was started by the author in 1948. The results are presented in this paper.

Root development in three varieties of *Lens esculenta* Moench, namely, 4315-I, 4328-23 and 4318-4 was studied by digging the seedlings on days as noted in Table I.

TABLE I

Root system at different stages of development

| Days after sowing | Root length in cm. | No. of secondary roots | Area covered (sq. cm.) |
|-------------------|--------------------|------------------------|------------------------|
| 4 | .37 | .. | .. |
| 5 | 1.20 | .. | .. |
| 6 | 1.60 | .. | .. |
| 7 | 1.70 | .. | .. |
| 8 | 2.80 | .. | .. |
| 9 | 3.10 | .. | .. |
| 10 | 3.50 | .. | .. |
| 11 | 4.00 | .. | .. |
| 12 | 4.40 | .. | .. |
| 13 | 5.00 | .. | .. |
| 14 | 5.00 | .. | .. |
| 15 | 9.90 | 2 | .. |
| 30 | 14.50 | 14 | 37.8 |
| 63 | 16.60 | 35 | 285.5 |

From the above table it can be seen that the radicle emerges on the fourth day after sowing and continues to grow till the fourteenth day of sowing. On the fifteenth day two branches appear on the root. There may be

a difference of few hours in the appearance of these branches. They are alternate and form an angle of 45°. Length of the primary root at this stage is 9.9 cm. Roots are yellowish white in colour and are provided with root tips which are transparent white. One-month old plant exhibits a primary root measuring 14.5 cm. and with fourteen secondary roots. The root system at this stage covers an area of about 37.8 sq. cm. The root system of the 63-day-old plant, i.e., at the initiation of reproductive phase shows branches of the fourth order having about 35 secondary roots. Roots possess many bacterial nodules which begin to appear when the plant is 20 days old. At this stage, the root system covers an area of about 285.5 sq. cm. and the main root measures 16.6 cm. Lateral growth of the roots is nearly confined to a radius of 10.5 cm. Roots generally arise at an acute angle.

The present work shows that the root system of *Lens esculenta* Moench occupies the soil to a depth of about 17 cm. and its lateral growth covers a radius of about 11 cm. So it may be concluded that this crop requires a cultivation of about 7.0" deep and that the seeds should be sown about 4.5" apart in rows and the distance between rows may also be kept not below 4.5" to allow proper growth of the roots.

I am highly thankful to Dr. N. K. Anant Rao, for valuable guidance.

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September 3, 1952.

MEIOSIS IN *MOMORDICA DIOICA* ROXB.

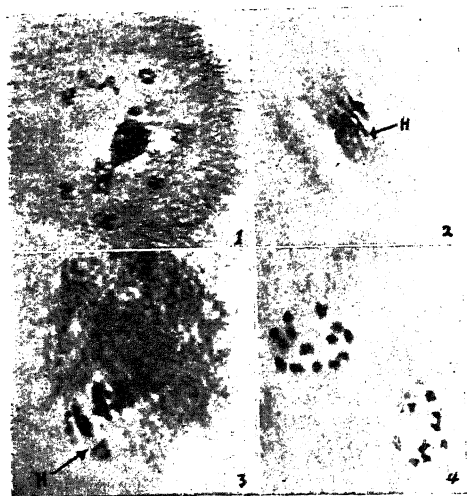
MEIOSIS in *Momordica dioica* does not seem to have been worked out. In other species of the genus *Momordica* such studies have been carried out, viz., in *M. Balsamina* $n = 11$ has been recorded by Whitekar (1933)* and McKay (1931)† and in *M. charantia* $2n = 22$ by McKay (1930)* and Yamaha and Suematsu (1936)† and Bhaduri and Bose (1947).

In the present studies meiosis was studied from smear preparations in two of the male plants of *M. dioica* selected from a population of 47 plants raised from seeds during 1949 in the Botanical Experiment Area at Sabour. Excellent preparations at all stages of meiosis were made by fixing the anther in acetic

* cf. Bhaduri and Bose, 1947.

† cf. Darlington and Ammal, 1945.

alcohol followed by smearing in aceto-carmine after mordenting the material with 4 per cent. iron alum. At diakinesis, 14 bivalents were distinctly observed, of which one was seen to be attached with the nucleolus (Fig. 1). Such a condition was observed in a number of pollen mother-cells. At I-Metaphase in the polar view, 14 bivalents were also distinctly seen. In some of the well spread I-Metaphase plates in side-views one of the pairs was observed to be heteromorphic (Fig. 2, H). It also showed a



FIGS. 1-4. Micro-photographs, meiosis in *Momordica dioica*.

FIG. 1. Late diakinesis with fourteen bivalents. One of the bivalents is seen attached with the nucleolus, $\times 950$.

FIG. 2. I-Metaphase (side view), showing a heteromorphic bivalent (H), $\times 1,450$.

FIG. 3. I-Metaphase (side view), showing a heteromorphic pair, disjoining earlier (H), $\times 1,450$.

FIG. 4. II-Metaphase (polar view), the upper half shows distinctly fourteen univalents, whereas the lower shows only thirteen univalents, one being out of focus.

tendency to disjoin somewhat earlier than the other bivalents (Fig. 3). At the end of the first division the chromosomes reconstitute the daughter nuclei and pass into the resting stage, developing a number of nucleoli and at this stage the maximum number of nucleoli observed was 4. But this stage was observed to be of short duration and the chromosomes remained somewhat contracted. The two chromatids in some of the chromosomes were actually seen to repel each other at ends, being only held together in the middle region, presumably at their centromeres.

At II-Metaphase 14 univalents were distinctly counted in each half, as are seen in Fig. 4 (upper half). In the lower half in the same plate one of the univalents was out of focus.

Pollen grain studies were made in the 7 male plants from the same population, as shown below :

| Plant No. | Percentage of fertile pollen |
|-----------|------------------------------|
| No. 1 | 94.5 |
| No. 2 | 57.9 |
| No. 3 | 92.1 |
| No. 4* | 81.3 |
| No. 5* | 95.2 |
| No. 6 | 86.2 |
| No. 7 | 82.4 |

* Studied at meiosis.

It may be of interest to record that in plant No. 5, rarely giant and joint pollen grains were also observed.

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October 1, 1952.

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LIFE-HISTORY OF *OCHROMA* *LAGOPUS* SW.

Ochroma lagopus Sw., the balsa or cork wood (used for aeroplanes) belonging to Bombacaceæ, is originally a native of S. America. A few trees are being cultivated successfully in the Anakapalli Agriculture Farm, Visakhapatnam District, wherefrom the material for the present investigation was obtained. The only previous embryological work in the family is that of Banerji¹ and Thirumalachar and Khan² on the development of the female gametophyte and floss in *Eriodendron anfractuosum* DC. and *Bombax malabaricum* DC. respectively.

The five stamens of the flower of *Ochroma* are united into a massive column on the surface of which are found the numerous transversely septate sinuous folds of anther lobes. In each fold, two anther loculi develop, which are subtended by two mucilage canals. The anther-

wall is 5-6-layered, of which the subepidermal layer develops into the fibrous endothecium and the innermost into the tapetum which is of the secretory type. The inner walls of the tapetal cells become cutinised. There is a marked secondary increase in the sporogenous cells. Microspore tetrads are tetrahedral and cytokinesis occurs by furrowing. The pollen grains are large, spherical, smooth-walled and triporate and are shed in the 2-nucleate condition.

There are numerous anatropous, bitegmic, crassinucellate ovules on axile placentæ. The micropyle is zig-zag. Linear as well as T-shaped megaspore tetrads occur of which the chalazal-most megaspore functions and forms the 3-nucleate embryo-sac according to the normal type. The synergids are hooked and show filiform apparatus. The egg is much longer than the synergids. The polar nuclei fuse just before fertilisation by which time the antipodals degenerate. There are numerous large starch grains in the cytoplasm of the sac. The antipodal end of the embryo-sac is somewhat tubular due to its being invested by a socket of thick-walled nucellus cells which form a postament in the developing seed.

The style shows five tracts of transmitting tissue in line with the five loculi of the ovary, consisting of finger-shaped, thin-walled richly protoplasmic cells. The funicles are also lined by radially elongated cells with rich cytoplasmic contents and prominent nuclei. These develop into floss after fertilisation. Entry of the pollen tube is porogamous. The pollen tube which is about 10μ in width, gives off a number of short branches in the region of the micropyle and persists without collapsing till the embryo becomes a large globular mass. As it is surrounded by the starch-bearing integumentary cells, it seems to act as a channel for the passage of food materials to the developing embryo, as in *Malvaceæ*.

Endosperm is of the nuclear type, and becomes cellular by the time the embryo is about 24-celled. In the mature seed the nucellus is completely absorbed. Embryo development conforms to the *Urtica* variation of the *Asterad* type. The mature embryo which is straight shows large fleshy cotyledons and a short suspensor. The palisade layer of the seed-coats is derived from the outer epidermis of the inner integument; outside this is a crystal layer. The funicle which becomes stout, persists in the seed and the floss developed from its epidermal cells helps in seed dispersal.

Embryologically, *Ochroma* differs from members of *Malvaceæ* in a number of features like

secondary increase in the microspore mother-cells, smooth-walled triporate pollen grains, secretory type of anther tapetum, anatropous ovules, presence of starch grains in the cytoplasm of the embryo-sac, hooked synergids, development of postament, straight embryo, short suspensor, etc., and there seems to be no justification for treating the family *Bombacaceæ* as a tribe of *Malvaceæ* as Bentham and Hooker did.

My thanks are due to Prof. A. C. Joshi and Prof. J. Venkateswarlu for their kind interest in the work.

Dept. of Botany,
Andhra University,
Waltair,
September 17, 1952.

C. VENKATA RAO.

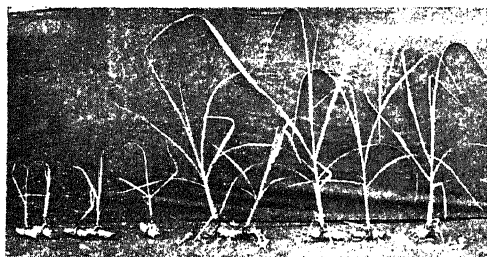
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EFFECT OF BENZENE HEXACHLORIDE ON GROWTH OF SUGARCANE

BUZACOTT¹ observed that 'Gammexane' intimately mixed with soil caused no observable effect on the development of the shoot buds on cane setts germinating therein but there was an inhibition of both primary and secondary root development. McDougall² noted stunting of primary roots developing from cane sett under some conditions where they contacted B.H.C. Dick³ and Mungomery⁴ secured satisfactory germination of cane with B.H.C. dust. Wilson⁵ observed no damage whatever to the cane when B.H.C. alone was applied in the drill at planting but noticed failure of germination and poor growth when the fertiliser mixed with B.H.C. was applied. In this note are reported certain effects of B.H.C. observed at Pusa on germination, growth, and root development in sugarcane, since 1949.

Experiments were carried in pots in which the local soil was mixed uniformly with 10, 50, 100, 200 and 400 parts B.H.C. containing 5.5% gamma isomer (Gammexane P. 520) per million of soil and setts of Co. 453 variety were planted. It was observed that the growth of plants had practically stopped after formation of 4, 2 and 2 leaves and they dried up in the treatments containing 100, 200 and 400 P.P.M. of B.H.C. With 50 P.P.M. the mother shoot or its tillers survived till 24 weeks after which they dried. The heights of plants after 4 weeks of growth were progressively poorer in order of increas-

ing dosage of B.H.C. Striking differences were seen in the roots of these plants (Fig. 1). The



Decreasing concentration of B.H.C.

FIG. 1. Effects of B.H.C. on Sugarcane Roots.

sett and shoot roots in the untreated plants were long and profusely branched and pointed at their tips. In 10 P.M. the roots were normal, but shorter. With increasing dosages of B.H.C. the roots became fewer, much shorter and their tips swollen into club-shaped woody structures.

This study stresses the need for caution in indiscriminate use of the B.H.C. compounds. Further studies with other crop plants and as to the mechanism of this effect are in progress.

Central Sugarcane S. B. D. AGARWALA.

Research Station,
Pusa, Bihar,
August 30, 1952.

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ISARIOPSIS GRISEOLA SACC. ON PHASEOLUS VULGARIS L.

A LEAF-SPOT disease of French beans (*Phaseolus vulgaris* L.) prevails during and after the rains in different parts of the Nilgiri plateau. Dark brown spots of varying sizes and shapes are found on the leaves. Blackish coremia develop on the lower surface of the spots. These measure 128 to 680 μ in length and 28 to 69 μ in thickness. They are composed of a bundle of parallel, brown, septate hyphae 4 to 6 μ thick. At the apices these hyphae diverge to form lighter-coloured conidiophores which are either curved or flexuose and septate. They measure 48-100 \times 4-6 μ . The conidia are formed singly at the tips of the conidiophores and are obclavate, straight or slightly curved, tapering towards the tip, one to five-septate (mostly three-septate),

hyaline, and measuring 34-83 \times 5-9 μ . The conidia germinate in 6 to 8 hours' time producing a germ tube from each end. The germ tubes of neighbouring conidia anastomose freely.

The pathogenicity of the fungus was determined by inoculating the leaves of healthy seedlings. Conidial suspensions were sprayed on the leaves with an atomizer and the inoculated plants were kept under bell jars for 24 hours. Suitable controls were maintained. Typical lesions developed on the leaves in 12 days and the coremia were observed in 14 days. The controls were healthy. The varieties Black Valentine, Bountiful Yellow and the local French bean were all equally susceptible.

The causal organism is found to be identical with *Isariopsis griseola* Sacc.¹ This organism has been reported to be pathogenic on French bean from Europe² and America.³ But it has not been recorded in India.

I am grateful to Mr. T. S. Ramakrishnan, Government Mycologist, for scrutinising this note.

Ootacamund,
October 30, 1952.

K. V. SRINIVASAN.

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PARALLEL TESTS WITH CALCUTTA AND HEBBAL (BANGALORE) TOADS FOR BOVINE PREGNANCY

THE recent publication of Rao and Krishnamurthy⁶ has led the present authors to communicate their findings on the parallel tests they were able to perform with the Calcutta and Hebbal toads during May-June and August this year. Prior to publication of this note, one of the present authors (J. L. B.) brought with him some Hebbal toads from Bangalore in May last through the courtesy of Dr. N. S. Krishna Rao. But before we could start our investigation, all the Hebbal toads died for totally obscure reasons; only 4 toads were left over for running parallel tests during May-June. In early August Dr. S. P. Ray-Chaudhuri of this Department, brought with him 25 Hebbal toads from Dr. N. S. Krishna Rao. Unfortunately, only 14 of them turned out to be males. Special care was immediately taken for their safe and sound housing, and none died before we could do at least one experiment with each of the 14 Hebbal toads.

For the series of parallel tests, 19 faeces samples from different pregnant and non-pregnant (lactating and sterile) cows and males (bull

and bullock) were collected, of which 7 samples came from the Bengal Veterinary College, Calcutta, and the rest from private owners. Each one of them was clinically confirmed afterwards. Since Rao and Krishnamurthy reported positive results in most cases, we concentrated our attention more on the non-pregnant and male cases.

The procedure (i.e., preparation of faecal solution, injection schedule, etc.) was followed in the same manner as described in our previous communications.^{1,2} It should be mentioned that in a few instances only we re-used some of those Hebbal toads which had survived the first test, after a good rest.

An analysis of the results of our investigation is presented in Table I. It will be apparent that the Hebbal toads reacted positively in all the instances. An initial 5 c.c. dose was enough for a good positive reaction in $\frac{1}{2}$ hr., only 5 reacting at the end of the first hour. On the other hand, the Calcutta toads never reacted positively, except in pregnant cases, up to a split-dose (5 c.c. each) administration of 20 c.c. volume of the same faecal solution. They gave consistent correct positives and negatives which are in consonance with our previously published results.¹⁻³

The quick response of the Hebbal toads prompted us to run a few parallel experiments with human urine specimens in August last. The results are also included in Table I. These data are too meagre to warrant any definite

TABLE I

| | Hebbal toad | | | | Calcutta toad | | | |
|----------------------------------------|-------------|----|-----|-----------------|---------------|----|-----|-----------------|
| | I | II | III | IV | I | II | III | IV |
| <i>Bovine faeces:</i> | | | | | | | | |
| 2 Pregnant (2nd trimester) | 2 | 1 | + | $\frac{1}{2}$ | 2 | 3 | + | 2 $\frac{1}{2}$ |
| 9 Non-pregnant (lactating, 16-3 mths.) | 6 | 1 | + | $\frac{1}{2}$ | 9 | 4 | - | |
| 1 Sterile | 1 | 1 | + | 1 | 1 | 4 | - | |
| 6 Bull | 5 | 1 | + | $\frac{1}{2}$ | 6 | 4 | - | |
| 1 Bullock | 1 | 1 | + | $\frac{1}{2}$ | 1 | 4 | - | |
| <i>Human urine:</i> | | | | | | | | |
| 1 Pregnant (threatened abortion) | 1 | 1 | + | $\frac{1}{2}$ | 1 | 3 | (+) | 3 $\frac{1}{2}$ |
| 2 Non-pregnant | 1 | 1 | + | $\frac{1}{2}$ | 2 | 4 | - | |
| 1 Male | 1 | 2 | (+) | 1 $\frac{1}{2}$ | 1 | 4 | - | |

I—No. of specimens. II—No. of dose (5 c.c.).

III—Reaction. IV—1st positive reaction at hour.

(+) Indicates weak positive (5-10 sperms).

conclusion. Nevertheless, the overall picture tempts us to question whether the Hebbal toads possess a sort of seasonal sensitivity in reference to gametokinetic reactions, since Rao and Krishnamurthy⁶ reported 12 negatives, most of which appear to be correct. Unfortunately, they did not mention the period when their experiments with 76 Hebbal toads were conducted, nor did they offer any annotation for the negatives. In the parallel series of tests, viewed in isolation, the Calcutta toads would be found to have reacted differently at the two places—Bangalore and Calcutta. But when both are taken together and viewed in the context of the entire situation, the Hebbal toads appear to be highly sensitive in that they reacted positively in every instance, be it cattle or human, pregnant or non-pregnant or males. And the period of experimentation may be said to cover May through August, although no test was done in July. We can, therefore, conclude that the Hebbal toads are refractory, if not useless, for 'pregnancy testing' at least for this short period.

The question of seasonal sensitivity in the Calcutta toads does not arise, since the efficiency and accuracy of pregnancy tests in human medicine with males of *Bufo melanostictus*, are well established in this laboratory¹ and elsewhere.^{1,5} More than 1,000 tests with human urine specimens and 250 with bovine faeces samples have to date been done routinely in this laboratory with ever-encouraging and satisfactory results. We have never encountered a false positive either in human or in bovine pregnancy tests. The results of tests reported by Rao and Krishnamurthy with the Calcutta toads in the parallel series seem somewhat disturbing, although a correct negative and a false negative have been recorded. Thus, the behaviour of the Calcutta toads at Bangalore seems paradoxical and is not easily explained, compared with our findings here. However, Rao and Krishnamurthy concluded that some substances, gametokinetic in reaction in the male toad, are present in the faeces of pregnant, non-pregnant and male cattle. They have further raised the question whether the feed of the cattle is responsible for the overall positive results. We have no adequate data before us either to support or to conflict with this suggestion. Our latest communication³ has briefly and partially answered the question of cattle fodder raised by Cowie.⁴ Now, even if we assume that the feed of the cattle may at certain places interfere with results, as presumably it did at Bangalore, may we not pose that it can be controlled for 'pregnancy testing' purposes?

We have not raised the question whether the difference in the gametokinetic reactivity of the two toads, Calcutta and Hebbal, is due to some physiological (reproductive) factors. We may, however, note in passing that the Hebbal toads can be told off from the Calcutta ones by the possession of a characteristic brick-reddish coloration on their somewhat smooth dorsum, although both apparently belong to the same species. On preservation this coloration tends to fade gradually to insignificance in the course of a few days. Whether these differences are varietal or specific or merely physiological, needs special investigation.

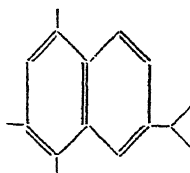
In the light of the above observations, further trial with locally available males of *B. melanostictus* is urged at different centres of Dairy Institutes in India to test the efficiency and adaptability of 'pregnancy testing' proposed by Bhaduri.^{1,2}

Our thanks are due to Dr. N. S. Krishna Rao and Dr. S. P. Ray-Chaudhuri for their courteous help.

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35, Ballygunge Circular Road,
Calcutta-19,
September 8, 1952.

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SYNTHESIS OF 2:4-DIMETHYL EUDALENE



ISOPROPYL BENZENE on methyl succinoylation in nitro-benzene solution in presence of anhydrous aluminium chloride yielded β -(p-isopropyl benzoyl)- α -methyl-propionic acid, m.p. 118–19° C. (Found: C, 72.03; H, 7.68; $C_{14}H_{18}O_3$ requires C, 71.79; H, 7.69 per cent.). Inverse Grignard addition of methyl magnesium iodide to the methyl ester of the above keto acid, on dehydration and hydrolysis furnished γ -(p-isopropyl benzene)- α : γ dimethyl-vinyl acetic acid boiling between 145–48° C./1 mm. (Found:

C, 77.12; H, 8.53; $C_{15}H_{20}O_2$ requires C, 77.59; H, 8.62 per cent.). Reduction of the substituted vinyl acetic acid with hydriodic acid and red phosphorus followed by cyclization in presence of anhydrous aluminium chloride in benzene solution gave 2:4 dimethyl-7-isopropyl tetralone-1 boiling between 122–23° C./1 mm. (Found: C, 83.22; H, 9.15; $C_{15}H_{20}O$ requires C, 83.33; H, 9.26 per cent.; 2:4-dinitro-phenyl hydrazone m.p. 132–33° C.). Grignard addition of methyl magnesium iodide to the substituted tetralone above, followed by dehydrogenation with sulphur gave 2:4 dimethyl eudalene, b.p. 115–16/2 mm.; m.p. 65° C. (Found C, 90.53; H, 9.27; $C_{16}H_{20}$ requires C, 90.57; H, 9.43; Picrate derivative m.p. 120–21° C.; Tri-nitro-benzene derivative, m.p. 137–38° C.).

Our thanks are due to Dr. B. H. Iyer for his kind interest in the work.

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Indian Inst. of Science, M. S. MUTHANA.
Bangalore,
November 15, 1952.

FOOD VALUE OF THE EDIBLE PORTION OF THE INDIAN CHANK *XANCUS PYRUM*

THE Indian sacred Chank (*Xancus pyrum*) is fished in large quantities on the East Coast of the Madras Presidency in the Tanjore, Tinnevely and Ramnad Districts. It is a monopoly of the Government of Madras and the fishing is conducted under the ægis of the Fisheries Department, the fishing season being from November to April. The Chanks find a ready market for making bangles and other articles of curios in West Bengal, Assam and East Pakistan.

The fishermen consume the edible portion of the Chank consisting of the muscular foot, which forms on an average 3 per cent. of the total weight of the shell. The edible portion is pulled out of the shell by means of a sharp knife. This note is presented with a view to evaluate its food values.

The popular method of using the flesh of the Chanks is as follows:—The flesh is boiled in water with a trace of salt for taste until it is nearly cooked. Then it is cut into thin slices and dried in the sun for two or three days. These chips are stored in air-tight containers and made use of when necessary by frying in deep fat, and are considered a delicacy by fishermen.

The table below gives the analytical values of both the Chank flesh in the raw state, and the Chank flesh as dry chips. The methods of

TABLE I
Food Values of Chank Flesh (raw) and Chank Flesh (dried chips)

| Particulars | Moisture % | Protein % | Fat % | Mineral matter % | Ca % | P % | Iron mg. % | Cu mg. % | NaCl % |
|---------------------------|---------------|--------------|----------|------------------------|---------|--------|------------------|----------------|-----------|
| Chank flesh (raw) | 67.50 | 24.84 | 0.82 | 1.84 | 0.13 | 0.094 | 2.71 | 0.43 | 0.35 |
| Chank flesh (dried chips) | 13.04 | 70.03 | 0.46 | 5.10 | 0.24 | 0.32 | 10.91 | 0.95 | 1.28 |

analysis are the same as those outlined in a previous paper.^{1,2} NaCl has been determined on the ash extract using Mohr's method.³

It will be seen from the above table that the food values of the flesh of Chank compare favourably with the preserved form and are in general agreement with those of fish. At present, as the quantity produced is not very large, only fishermen consume most of it. They are thus having a rich source of protein food. The protein and the minerals especially invite special attention and it is to be hoped that ere long the Chank flesh chips will become quite popular with other classes of people as a high protein food in diet and that the supply will also improve.

The assistance of Sri. A. D. Issaac Rajendran, Research Assistant, Tuticorin, in making available the samples for our investigations is acknowledged.

Fisheries Tech. Station, R. VENKATARAMAN.
Kozhikode, S. T. CHARL.
November 11, 1952.

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A CASE OF NATURAL ADAPTABILITY OF ANOPHELES LARVAE TO SEA- WATER

It is found that oviposition responses of some *Anopheles* in captivity are quite different from the responses found in nature (Mehta,¹ Thomson²). The present account is the case of *Anopheles* larvae that were found breeding in the sea adjoining the Madras beach. On 27th August 1952, two *Anopheles* larvae of the First instar stage were found in sea-water taken from the shore at the breaker-level, and brought to the University Zoology Laboratory. In order to test whether they would survive, the larvae were kept in a finger-bowl of sea-water for further observation. The water was renewed

every day to keep the salinity and pH without much deviation. The salinity tested was found to be 32.68‰ and pH 8.3. It was found that the larvae were very active in their habits, moulted as usual, passed through all the larval stages, pupated, and finally the adults emerged from the pupae on the 12th day. The adults were both males, and were determined to be either *Anopheles subpictus* or *A. vagus*, because the males of both species possess the same characteristics.

First instar found on August 27th, second instar emerged on August 29th, third instar on September 1st, fourth instar on September 4th, pupa on September 6th, and adult on September 8th.

There are no drains directly entering the sea for these larvae to have been washed down. The river which opens into the sea had its mouth closed by the sand bar, nor was there any rain at that time to wash down water from any artificial pools nearby.

This observation is interesting because of two unusual features, one of which is the adaptability of the larvae to sea-water. *A. subpictus* and *A. vagus* are found everywhere in India, their larvae being found in a very wide range of habitats, from the purest to the foulest types of water. But, in nature, they are not found to breed in sea-water. The second is their capacity to resist the pounding action of the waves on the margin of the shore. This is really surprising, because one of the methods employed in eradicating mosquito larvae is to resort to agitation of water by producing fast currents or violent waves. Here, on the other hand, the agitation of water is mightier than that produced artificially.

Zoology Res. Laboratory, V. O. SEBASTIAN.
Chepauk, Madras,
November 11, 1952.

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BUFFER CAPACITY AND RELATED PROPERTIES OF SOME SOILS OF DELHI AND ITS NEIGHBOURHOOD

ORGANIC acids in the neighbourhood of their half-neutralized states exert strong buffer action. Using half-neutralized acids of different dissociation constants, Schofield⁵ made use of their

correspond more closely to moisture relationship existing under natural field conditions. Applying similar ideas to the present instance, it is clear that the pH at which the buffer curves cut the line of zero-exchange of bases, should correspond to the pH value of the soil. Table II records the pH of the samples as determined

TABLE I

| Soil | pH 1.3 | pH 2.9 | pH 4.6 | pH 7.2 | pH 9.8 | pH 12.5 |
|----------------------|-----------|--------|--------|--------|--------|---------|
| Gheora 0"-6" | .. -16.62 | - 8.84 | - 2.50 | - .9 | + 4.60 | + 9.90 |
| Gheora 6"-12" | .. -16.16 | - 7.63 | - 4.20 | - .68 | + 8.00 | +12.47 |
| Gheora 12"-22" | .. -20.37 | - 8.8 | - 3.93 | - .34 | + 9.35 | +17.68 |
| Gheora 22"-36" | .. -26.14 | -11.78 | - 8.08 | - 1.8 | +10.1 | +18.18 |
| B.D. Plot 0"-6" | .. -21.51 | - 6.22 | - 5.86 | -50 | + 4.70 | + 7.42 |
| D.B. Plot 6"-18" | .. -21.74 | - 7.30 | - 3.60 | .00 | + 4.80 | +15.3 |
| B.D. Plot 18"-30" | .. -21.72 | - 7.40 | - 3.70 | .00 | + 4.80 | +15.8 |
| B.D. Plot 30"-42" | .. -32.56 | -11.70 | -11.0 | - .51 | + 4.80 | +14.8 |
| Kamruddinnagar 0"-6" | .. -15.03 | - 8.00 | - 2.40 | - .50 | + 4.4 | +13.2 |

* Negative sign indicates that the soil gives up base to the buffer solution to be isohydric with the buffer in respect of hydrogen-ion concentration.

buffer properties to study base saturation of soils at different pH values. Raychoudhuri and co-workers⁴ used the same technique in their studies on the Red soils of India in respect to their buffer properties and pointed out their importance in soil-classification. Working with some soils of Delhi and its neighbourhood, it has been found that these buffer curves would yield valuable information regarding mineralogical make-up of soils. Data obtained with these soils are shown in Table I above.

The milliequivalents of base exchanged when plotted against the corresponding pH gave smooth curves with an inflection at or near about pH 4.6. Pure mineral specimens of kaolinite, montmorillonite, and illite have been examined similarly, and from the similarity of behaviour, the soils have been found to be montmorillonitic. Chemical analysis and electrometric titration of the clay-fractions confirmed the results.

The buffer curves can thus be utilised on the same lines as the electrometric titration curves to obtain useful data on the electrochemical nature of soil acidoids.

It is usual to obtain the soil pH values with a fixed soil water ration, either electrochemically or colorimetrically. Puri and Sarup³ have pointed out the inherent defect in such a procedure and suggested the iso-hydric pH value as an index of soil reaction. Mattson¹ called this pH the point of exchange neutrality. Megeorge² in a recent publication, has pointed out the similarity between the iso-hydric pH values and the pH values of soil paste which

from the buffer curves and by the glass electrodes at soil water ration 1:2.5.

TABLE II

| Soil No. | Glass Electrode (pH) | Buffer curve (pH) |
|----------------|----------------------|-------------------|
| Gheora I | .. 7.48 | 7.6 |
| Gheora II | .. 7.55 | 7.2 |
| Gheora III | .. 7.74 | 7.2 |
| Gheora IV | .. 7.90 | 7.4 |
| B.D. I | .. 7.60 | 7.4 |
| B.D. II | .. 7.68 | 7.1 |
| B.D. III | .. 7.68 | 7.1 |
| B.D. IV | .. 7.88 | 7.5 |
| Kumruddinnagar | .. 7.45 | 7.2 |

It will be observed that the pH indicated by the glass electrode is generally higher than that obtained from the buffer curve.

The buffer pH is, however, more informative than the pH determined by the conventional methods; the former value is related more closely with the saturation state of the soil acidoids.

The author is thankful to Dr. S. P. Raychoudhuri for his criticism and suggestions during the course of the work.

Indian Agri. Res. Inst.,
New Delhi,
July 28, 1952.

A. K. Das.

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REVIEWS

Major Faults on Power Systems. By A. G. Lyle. (Chapman & Hall Ltd.), London. Pp. 355. Price 45 sh.

The volume is the latest of a series of monographs on Electrical Engineering published under the editorship of Mr. H. P. Young.

The book aims at a critical examination of the behaviour of power systems under fault conditions. The author has indicated the method of approach to the problems in connection with faults and their consequences, rather than giving a formal, comprehensive and, perhaps, tedious treatment of every possible fault which can arise. More emphasis has been laid on discussing what actually happens and the magnitudes of current and voltage attending the incidence of various kinds of faults, leaving detailed information on switchgear, protective gear and transient phenomena to be obtained from the many excellent and specialised books already available. Only such descriptions and discussion on the protective equipments have been included which are essential to the investigation of their performance.

In the introductory chapter the origin and effects of faults and some of the phenomena associated with insulation failure are discussed; the magnitudes of currents and voltages due to lightning and switching surges are investigated. The range and scope of surge voltages have been discussed in an elementary way with the help of Heaviside's operational calculus. Empirical formulæ are developed from an analysis of sudden short circuits on alternators and these are checked with actual test results. The consequences of fault—explosion and fire—are discussed in the next chapter and the means to restrict the damage due to fire are indicated.

As a background to the understanding of the solution of more complicated problems on network analysers, it is necessary to understand the solution of simple cases by calculation. Such a background is provided in the two chapters dealing with elementary fault calculations by the method of symmetrical components and calculation of system faults for different types of faults. In his effort to simplify the presentation of fault conditions, however, the author's remark that "transformers generally have the same reactance for all sequences" is somewhat vague and may lead to misunderstanding, since the values of zero sequence impedances depend

so much on the method of connection of the transformer windings and other apparatus.

Three chapters are devoted to protective devices which have been subclassified by the author as: (a) self-contained protective devices consisting of surge diverters, surge absorbers, Petersen coil; and (b) ancillary protective gear such as relays and relay protective schemes whose function is to operate circuit breakers. Two chapters are devoted to oil circuit breakers and a third chapter deals with high voltage outdoor circuit breakers.

Chapter XI deals with the design of switchgear structures as adapted in British systems. In the next chapter consistency of systems design is discussed stressing the necessity of co-ordination of fault capacity with circuit breaker capacity, size of connecting conductors and current transformers and potential transformers. Sudden heating and its effect as also the protection of potential transformers are discussed.

A whole chapter has been devoted to the problem of Neutral Inversion—some new material in books of this nature. As pointed out by the author, the incidence of neutral inversion is rare but possible. Hence an idea as to the causes leading to neutral inversion, its effect and magnitude will be useful in that necessary preventive measures can be taken where needed.

In each chapter a number of examples and calculations are given in illustration of the principles discussed. There are a few printing mistakes and omissions which, it is hoped, will be corrected in the next edition. References, mostly from English sources, are given at the end of each chapter.

Mr. Lyle's book gives a critical review of the British practice and is a very useful addition to the existing literature. Though primarily written to assist the practising engineer, the book will also be very useful to the advanced students in electrical engineering.

C. S. GHOSH.

Elements of Radio Engineering. By H. I. F. Peel. (Published by the Cleaver-Hume Press Ltd., London), 1952. First Edition. Pp. viii + 232. Price 10 sh. 6 d. nett.

When a large number of books on radio are available, there must be justification for a book of this kind. The author has really produced

a book which can justify its existence. It is written in a very elementary manner and is most readable. It covers the ground necessary for our diploma students in other branches of engineering who have to be taught something about radio communication.

The book is divided into 12 chapters covering valves, A.C. theory, valve as an amplifier, use of capacity and inductance in A.C. and D.C. circuits, power supply, tuning circuits, oscillator circuits, detector circuits, the receiver, radio measurements and the cathode ray oscillograph. A very useful part of the book is the examination questions and answers. There is a brief index. Most of the treatment is with the help of graphs. There are a very large number of very useful and extremely well-drawn diagrams. The printing and get-up of the book is very good.

The book can be very strongly recommended to all engineering diploma students who need to acquire an elementary knowledge of radio. It is the type of book that should find a place in the science section of school and Intermediate College libraries for the use of students who display an interest in radio communication.

S. V. CHANDRASHEKHAR AIYA.

The International Review of Cytology, Vol. I.

Edited by G. H. Bourne and J. F. Danielli. Academic Press Inc. Publishers, New York), 1952. Pp. 368. Price \$ 7.80.

The *International Review of Cytology* would be gladly welcomed not only by the specialists concerned but by all students of the biological sciences. The Editors have wisely decided to keep the scope of the reviews very wide in order that all aspects of cell biology may be covered. Though the articles are "individual and unrelated reviews of specific subjects", there is a balance in the topics presented.

Important lines of advance in cytological technique have been well summarized in "The Application of Freezing and Drying Techniques in Cytology" by L. G. E. Bell and "The Electron-Microscopic Investigation of Tissue Sections" by L. H. Bretschneider.

The problem of differentiation and development receives attention from two different angles: G. Fankhauser—Nucleo-Cytoplasmic Relations in Amphibian Development, and C. L. Huskins—Nuclear Reproduction. Huskins has summarized data which "though none alone may be conclusive, together suggest a need for revision and extension of some of our more orthodox concepts on various aspects of repro-

duction of the nucleus and its components and the role of the nucleus in differentiation and development" (p. 21). It is questionable whether his defence of the use of the terms *polyploidy*, *polysomaty*, and *polyteny* synonymously would appeal to other workers. The statement pertaining to the DNA charge in nuclei (p. 22) appears self-contradictory because the first part conveys a sense exactly opposite to that of the latter half. It is of course now recognized that the DNA content of nuclei are correlated with the number of chromatids present.

The mechanism of mitosis, though debated over many years, has scarcely received any satisfactory solution. In a persuasive article, "Structural Agents in Mitosis", based on observations of the changes in the physical properties of the dividing cell, Swann argues that chemical agents are most likely to be responsible for the structural changes in the cell during mitosis. The two articles, "Enzymatic Processes in Cell Membrane Penetration" by Th. Rosenberg and W. Wilbrandt and "Protoplast Surface Enzymes and Absorption of Sugar" by R. Brown deal with similar topics. The first one is more comprehensive and critical. The physico-chemical basis for osmotic work done by the cell is ascribed to the folding and unfolding of protein molecules by R. J. Goldacre, who argues out convincingly all the implications of such a concept, marshalling impressive evidence in support.

With the use of dyes in cytological work expanding in scope every year, it is gratifying to find that an able and critical summary (M. Singer: "Factors which Control the Staining of Tissue Sections with Acid and Basic Dyes") of the various factors affecting the process of staining has been included in this volume. Though the subject of bacterial cytology is still a controversial one, considerable weight is lent to the views of some of the workers in view of the fact that most of their observations using the standard cytological techniques have been confirmed by examining living cells by phase-contrast microscopy. Notwithstanding this, one wonders whether the time is ripe for a re-orientation of our ideas on Bacterial Systematics and Evolution based on the present knowledge of cytology as suggested by Bisset ("Bacterial Cytology"). "The Behaviour of Spermatozoa in the Neighbourhood of Eggs" by Lord Rothschild provokes the question whether this review has not been a little premature.

Advances in other fields of cytology summarized are: Enzymic Capacities and Their

Relation of Cell Nutrition in Animals" by G. W. Kidder, "Reproduction of Bacteriophage" by A. D. Hershey, "The Cytology of Mammalian Epidermis and Sebaceous Glands" by W. Montagna, and "The Histochemistry of Esterases" by G. Gomori.

Notwithstanding the many critical remarks which might come to the mind of the reader on a perusal of the articles, one cannot fail to be impressed by the wealth of information and the stimulating discussions contained between the covers of this book. The question of striking a proper balance between facts and hypotheses has always been a tricky one and if, in this volume, the balance appears weighted a little more in favour of the latter, one has to remember that after all hypotheses, once their essential nature is understood, play a very useful role in any branch of science which is advancing rapidly.

In regard to ideas and theories in cell biology, nothing can be more salutary than a consideration of the following remark by Hughes ("Some Historical Features in Cell Biology"): "In conclusion one may say that since in some ways cell biologists are on old ground working with new implements it would be as well if they recognized more fully the antiquity of their sites and looked out for the old forgotten tracks, along which something of value might still be found. A few more ideas, however ancient, would still be useful in cell biology" (p. 6).

If the first volume is any indication, one can look forward to a number of valuable publications in this series giving authoritative and critical summaries of advances on all the fronts of cytology and cell physiology.

M. K. SUBRAMANIAM.

Nuclear Data. (Supplement 3 to N. B. S. Circular 499). (U. S. Department of Commerce, Washington), 1952. Pp. 66. Price \$4.25.

This is the third and the last supplement to the main compilation on Nuclear Data, N. B. S. Circular 499, and contains data reported during the period January 1951 to July 1951. Nuclear physicists, radio-chemists and other workers in nuclear science are now quite familiar with this valuable work of reference, which presents a comprehensive collection of experimental values of half-lives, radiation energies, relative isotopic abundances, nuclear moments and cross-sections. Decay schemes and level diagrams are given wherever possible. It is estimated that at present over 1,000 new measurements of

nuclear properties are being reported each year in some thirty different journals and the need for a suitable listing of available data is keenly felt by all workers in nuclear physics. The need is satisfactorily met by this work on Nuclear Data. The value of Supplement 3 is further enhanced by inclusion in it of a list of fission and spallation papers and a list of packing fraction differences. It has been announced that the N. B. S. nuclear data group will continue to do this important work, in future, in conjunction with the semi-monthly abstract journal, *Nuclear Science Abstracts*.

B. V. THOSAR.

The Skeleto-Muscular Mechanism of *Stenobracon deesae* Cam.—An Ectoparasite of Sugarcane and Juar Borers of India, Part I: Head and Thorax. By S. Mashhood Alam. Edited by Prof. M. B. Mirza. (Aligarh Muslim University Publications, Zoological Series, No. 3). Pp. 74. Plates ix. Price Rs. 5-8-0.

The publication under review would appear to be a part of a thesis on which Dr. Mashhood Alam had been working and deals with the skeleto-muscular mechanism of the head and thorax of *Stenobracon deesae* Cam., a common hymenopterous parasite of economic importance. The author has dealt with the subject in an elaborate and thorough manner. The large mass of descriptive matter is interspersed with brief discussions of the views of earlier workers in the field. Descriptions of the skeletal structure and the musculature of the body—an aspect difficult of investigation and often neglected—have been rendered possible by the successful technique employed; and the work is altogether a notable contribution to our knowledge of the intricate skeleto-muscular mechanism of the insect body. The text is adequately supported by a good number of well-drawn figures printed on art paper. The publication is altogether attractive both in form and content. Dr. Mashhood Alam is indeed to be congratulated on the successful handling of a difficult and exacting research problem under the inspiring guidance of Dr. M. A. H. Qadri and Prof. M. B. Mirza.

D. S. RAO.

Indian (Mysore) Linaloe Oil. By Sri. S. G. Sastry (Board of Scientific and Industrial Research, Government of Mysore).

This monograph on Mysore Linaloe Oil is a very welcome addition to the literature on essential oils. The interesting and vivid story

of the history of the origin and development of Linaloe plantation in Mysore is another epic in the development of plantation industry in India. Every part of the linaloe tree contains oil, Mysore specialising in the production of oil from the berries and husks. The cultivation potentialities of this plant are very great and all who are interested in the subject must study this monograph.

K. N. M.

Biologie D'Anopheles Gambiae. By M. H. Holstein. (Recherches en Afrique-Occidentale Francais. Organisation Mondiale de la Santé. Palais des Nations, Geneve), 1952. Prix : Fr. s. 8, 10/-, \$ 2.00.

By presenting the monograph on the biology of *Anopheles gambiae* Dr. Holstein has done an invaluable service not only to the science of malariology, but also to some of the general biological problems for which evidence at present is scanty. Chapters I and II are devoted to the description of the meteorological conditions of French West Africa, and to the techniques used for collection, transport, dissection etc., of *A. gambiae*. Chapters III to VII deal with the life-cycle, individual variations of various stages, nocturnal activities of adults, role in malaria transmission, and racial peculiarities of this notorious African malaria-carrier. All these facts, collected during two years of painstaking investigations, and vividly described within the confines of a beautiful handbook is one which every student of malariology would like to possess. Another study of great interest is the comparison of the various responses under natural and laboratory conditions, which in mosquitoes are often at variance with one another. The results are also critically analysed with reference to a review of all the existing literature pertaining to the problem. Such a work should help to stimulate the publication on similar lines monographs of other malaria-carriers of the different parts of the globe, whose literatures are scattered far and wide.

The great merit of the book lies in the exposition of two biological phenomena. One is the resistance of *A. gambiae* to withstand the rigours of prolonged hot summer months. True hibernation in mosquitoes is found in cold seasons, whereas in hot seasons they are supposed to undergo rapid mortality. Here, on the other hand, *A. gambiae* adults pass through the dry season in a way mid-way between gonotrophic dissociation and concordance, which the author

calls 'pseudo-hibernation'. The second is the discovery of racial differentiation of *A. gambiae*—the zoophylic and anthropophylic forms by careful studies on the maxillary index, precipitin tests and larval breeding places. The paucidentate populations are anthropophylic, breeding in water with less of organic content of vegetable origin, the multidentate populations being zoophylic, breeding in water of large organic-matter content. The terms 'organic' and 'inorganic' forms used by the author may be convenient expressions to denote the differences, but what is noteworthy is that the coincidence of structural peculiarities and physiological behaviour is an indication of the gradual evolution of physiological species.

The annexes giving details of the distribution of *A. gambiae* throughout the Ethiopian region, the sporozoite-rate, and key to the identification of adults and larvæ of *Anopheles* of French West Africa are valuable additions to the book.

V. O. SEBASTIAN.

Books Received

Phylogeny and Morphogenesis. By C. W. Wardlaw. (Macmillan & Co. Ltd.), 1952. Pp. 536. Price 42 sh.

Tables of the Bessel Functions. (United States Government Printing Office, Washington), 1952. Pp. xi + 60. Price 40 cents.

Commercial A.C. Measurements. By G. W. Stubbings. (Chapman & Hall), 1952. 3rd Edition. Pp. xvi + 377. Price 50 sh.

Alternating Current Wave Forms. By Philip Kemp. (Chapman & Hall), 1952. 2nd Edition. Pp. ix + 406. Price 50 sh.

The Basis of Mine Surveying. By H. Hardlock. (Chapman & Hall), 1952. Pp. xii + 301. Price 30 sh.

Science Magic. By Kenneth M. Swizy. (McGraw-Hill & Co.), 1952. Pp. x + 182. Price \$ 3.75.

Thermal Diffusion in Gases. By K. E. Grew and T. Libbs. (Cambridge University Press), 1952. Pp. xi + 143. Price 22 sh. 6 d.

High Speed Photography. By G. A. Jones. (Chapman & Hall Ltd.), 1952. Pp. xiii + 311. Price 42 sh. net.

Designing by Photoelasticity. By R. B. Heywood. (Chapman & Hall Ltd.), 1952. Pp. xv + 414. Price 65 sh. net.

Superconductivity. By D. Shoenberg. (Cambridge University Press), 1952. Pp. x + 256. Price 30 sh.

Ink and Paper in the Printing Process. By Andries Voet. (Interscience Publishers Inc., New York), Pp. xii + 213. Price \$ 5.90.

SCIENCE NOTES AND NEWS

Smoke Points of Fatty Oil—White Oil Mixtures

Shri J. G. Kane and G. M. Ranadive, Department of Chemical Technology, University of Bombay, Bombay 19, write as follows:

Smoke point of a fatty oil is a guide to the use of the oil as a frying or a heating medium. Small amounts of fatty acids depress the smoke point of fatty oils considerably (Morgan, D. A., *Oil and Soap*, 1942, 19, 194). The authors observed that addition of white oil to fatty oil markedly lowered the smoke point of the latter in almost the same manner. Therefore if refined or crude fatty oils show very low smoke points inconsistent with their f.f.a. contents, white oil may be suspected to be present in them.

Introduction of the Exotic Cichlid Fish, *Tilapia mossambica* Peters. in Madras

Sri. D. D. Peter Devadas and P. I. Chacko, Freshwater Biological Station, Madras, write as follows:

A consignment of 500 fry (12 to 35 mm. in size) of *Tilapia mossambica* was imported to Madras from Ceylon on 8th September 1952. The fish were transported without any casualty in a tin container sealed with oxygen. This is the first instance of introduction of this exotic fish to India. Within a short time of three months the fish has responded favourably to the new environmental conditions of Madras. In the Chetpat Fish Farm it has not only attained to a size of 135 mm. and weight of 50 gm. by the end of November 1952 but has also bred prolifically. It grows well in association with local species like *Catla catla*, *Cirrhina mrigala*, *Labeo rohita*, *L. fimbriatus*, *Cyprinus carpio* and *Osphronemus goramy*. Non-cannibalistic habit, rapid growth and propagation, parental care, harmless association with indigenous species, adaptability to different types of fresh and brackish waters, capacity to withstand handling and transport and algicidal propensities make *Tilapia mossambica* an ideal fish suited for culture in South Indian waters, many of which dry during the summer.

A Simple Method of Germinating Sweet Potato Seeds

Messrs. L. Venkataratnam and K. Satyanarayanamurthy of the College of Agriculture, Bapatla, Madras, write as follows:

Seeds resulting from hybridisation of different clones of sweet potato (*Ipomoea batatas* Lam.) are hard-coated and do not germinate even after months of storage. Among the various attempts made to germinate the seeds, treatment with sulphuric acid was found the best for breaking dormancy and the imperviousness of the seed-coat. Over 60 per cent. germination was obtained as against 4 to 5 per cent. secured from untreated seeds.

Moist seeds are dropped into concentrated sulphuric acid just adequate to soak the seeds and the seeds are allowed to stand in the acid for about 10 minutes and then poured in a basin full of water. These can be washed and sown immediately. The treatment is simple and has no injurious effects. Dry seeds do not respond to the same extent as moist seeds as sufficient heat has to develop for proper wearing down of the seed-coat.

We are grateful to Professor T. C. N. Singh of the Annamalai University for many useful suggestions.

The Bose Institute—35th Anniversary Meeting

The Bose Institute celebrated the 35th Anniversary of its foundation on November 30th, 1952. The Director, before presenting his report on the working of the Institute for the past year, took the opportunity to refer to the 50th Anniversary of the publication in 1902 of Acharya Jagadish Chandra's book *Response in the Living and the Non-Living* which had at the time of its publication evolved a great deal of interest in learned circles. He reviewed in the light of the present-day knowledge, Acharya Bose's contribution to response phenomena in general. He also announced the receipt of a legacy of £ 5,000 from the Executors of the late Miss Edith Keating of London, income from which will be utilised for the creation of a Fellowship in the Bose Institute, which will be known as the Edith and Richard Keating Research Fellowship.

Award of Research Degrees

The following students of the Institute of Science, Bombay, have been declared eligible by the University of Bombay for the Degree of Doctor of Philosophy in Physics on the basis of the theses in the subjects shown against their names:

Shri K. S. Korgaokar, "Influence of Oxygen on the First and Second Positive Systems of Nitrogen"; Shri B. S. Patil, "Study of the Rotational Energy Distribution in Some Hydrocarbon Bands"; Shri G. K. Mehta, "Probe and Spectroscopic Studies in the High Frequency Discharges"; and Shri D. D. Desai, "Influence of Argon on the First and Second Positive Systems of Nitrogen".

Indian Botanical Society

The following Officers of the Indian Botanical Society have been constituted for the year 1953 as the result of election at the 32nd Annual General Meeting of the Society held at Lucknow:—

President: Dr. K. A. Chowdhury, Dehra Dun; *Vice-Presidents*: Dr. K. Biswas, Calcutta; and Dr. S. N. Das Gupta, Lucknow; *Honorary Secretary*: Dr. R. Misra, Sagar; *Treasurer and Business Manager*: Dr. T. S. Sadasivan, Madras; *Editor-in-Chief*: Dr. A. C. Joshi, Jullunder.

Surface Conductive Glass

Tin salts can be baked into the surface of glass, changing it from an insulating material into a conductor for electricity. From this fact spring several novel applications including defrosting windows and wind screens and 'cold' lighting devices.

Hydrodynamic Lubrication

The behaviour of a journal bearing running eccentrically in a bush has been studied to check the validity of Sir Geoffrey Taylor's criterion for critical speed, worked out for one cylinder rotating concentrically inside another. Results of experiments so far show that the

designer who arranged that Taylor's value was not exceeded would be on the safe side. This research is important because of the advent of the gas turbine and the introduction of rapidly rotating machinery for refrigerators and so on. They demand bearings running faster than has been usual up to now.

Protonsynchotron at Canberra

An atomic accelerator producing protons with energy of the order of 15,000 mev. is being built by Professor M. L. Oliphant at the Australian National University, Canberra. The protonsynchotron under construction is an improvement over the better known cyclotrons and synchotrons in the U.K. and the U.S.A. One of the limiting factors in the cyclotron principle thus far has been the focussing of particles within the magnetic field so that they hold on to the destined path. A discovery made at Brookhaven improved the focussing to a degree previously unknown. The Canberra construction is at the stage where the new improvement could be incorporated. With the extended range thus made possible for the study of properties of matter, Professor Oliphant and his assistants hope to obtain significantly new knowledge on the effects of particles on atomic nuclei.

Indian Phytopathological Society

At the Annual General Meeting of the Indian Phytopathological Society held during the last session of the Indian Science Congress at Lucknow, the following members were elected to the Council for 1953:

President—Dr. R. S. Vasudeva; *Vice-President*—Dr. S. N. Das Gupta; and *Secretary-Treasurer*—Dr. R. Prasada.

NOTICE

All material intended for publication in *Current Science*, corrected proofs, books for review and exchange journals, may please be sent to the Editor:

Professor G. N. Ramachandran,
A. C. College of Technology,
Guindy, Madras-25.

Remittances, correspondence regarding subscriptions to the journal, advertisements and requests for missing numbers, etc., may please be addressed to:

The Manager,
Current Science Association,
Malleswaram P.O., Bangalore-3.

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THE CHRISTIANSEN EXPERIMENT*

THE present article is concerned with the phenomena observed in the well-known optical experiment embodying the principle of the so-called Christiansen filters used for isolating monochromatic radiation from white light. A transparent isotropic solid is powdered and placed inside a flat-sided cell of glass, and the latter is then filled up with a liquid of which the refractive index is adjusted to equality with that of the powder for any desired wavelength in the spectrum. The cell then becomes optically transparent for such wavelength, which the rest of the spectrum is not transmitted but only diffused in its passage through the cell.

The material usually recommended for use in Christiansen filters is powdered glass which needs to be specially prepared. We have found that a convenient substance to employ in experimental studies of the Christiansen effect

is hexamethylenetetramine, also known as hexamine or urotropin, which is both inexpensive and readily available as a crystalline powder. Hexamine is optically isotropic and its refractive index is intermediate between those of benzene and carbon disulphide in either of which it is nearly insoluble. Beautiful chromatic effects are observed when hexamine powder is placed in a cell and filled up with a mixture of benzene and carbon disulphide in the proportion of roughly one to four. For visual observations, it is convenient to employ, instead of a flat-sided cell, a stoppered hollow prism of 60° angle to contain the material. The advantage of doing this is that the prism functions both as a containing cell and as a dispersing apparatus. All that is necessary is to view the incandescent filament of an electric lamp from a distance through the prism held close to the eye. The spectral character of the transmitted light then becomes immediately evident, and by moving the eye to different positions on the prism face, the various effects described and illustrated below may be observed.

* Sir C. V. Raman, "The Theory of the Christiansen Experiment," *Proc. Ind. Acad. Sci.*, 1949, **29A**, 381-90. See also, 1949, **30**, 211-15 and 277-83.

The spectral character and intensity of the transmitted light in the Christiansen experiment is influenced by several factors, of which the depth of the column through which the light filters is of particular importance. The set of six spectrograms reproduced in Fig. 1 exhibits

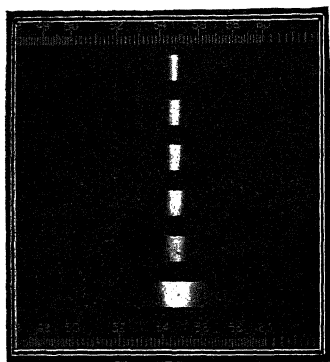


FIG. 1

the sharpening of the spectral band of transmission with increasing thickness of the filter; the uppermost corresponds to a thickness of 18 millimetres and the lowest to 1.5 millimetres. The exposure given had to be greatly increased with increasing thickness of the material so as to record the transmitted light with approximately the same intensity.

The size of the particles of the powder is also of great importance in determining the spectral character of the transmitted light. This effect is illustrated in the series of four spectrograms reproduced in Fig. 2. These were obtained with

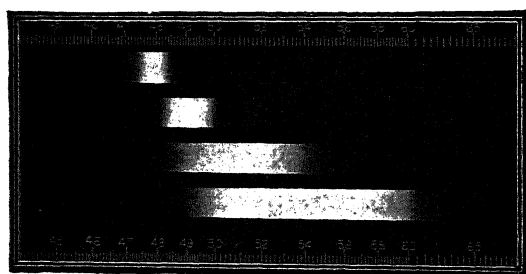


FIG. 2

powdered glass the particles of which had been graded by sieving and elutriation, into four groups having respectively as average diameters 300μ , 100μ , 18μ and 9μ , the thickness of the layer traversed being the same, viz., 3 mm. The composition of the benzene-carbon disulphide mixture covering the powder was also adjusted to be as nearly as possible the same in the four cases. From the figure it will be seen that spectral width of the transmitted light becomes

very great when the particle size is small. The widening is also totally unsymmetrical; the spectrum stretches further and further towards the red, while its short wavelength limit remains unaltered.

The series of spectrograms reproduced as Fig. 3 exhibits another effect of interest. They

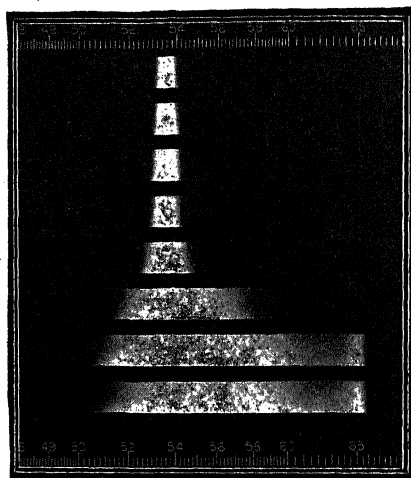


FIG. 3

were obtained by focussing the light of a carbon arc on the slit of a spectrograph after passage through a cell containing hexamine powder suspended in a considerable excess of a benzene-carbon disulphide mixture. In the first of the series, the powder was distributed more or less uniformly throughout the entire volume of liquid. The subsequent spectrograms were recorded at short intervals of time following each other as the powder settled down in the cell, finally leaving the region traversed by the light beam nearly free of suspended powder except for the finest particles of all. The progressive increase in the spectral width of the transmitted light is particularly conspicuous in the last few spectrograms. The unsymmetrical character of this broadening is also strikingly evident. The effects noticed are a consequence of the diminishing quantity of suspended solid which is effective as well of the increasing fineness of its particles. The former of the two effects can be demonstrated separately by comparing the character of the transmitted light when the powder has all settled down to the bottom of the cell with that observed when the powder is distributed uniformly throughout the volume of the liquid.

The difference in the dispersive powers of the solid and the liquid also plays a decisive role in the Christiansen experiment. This be-

comes particularly obvious when this difference is very small. The series of spectrograms reproduced in Fig. 4 shows the spectral character of the light transmitted through different thickness of potassium chloride powder immersed in tetrachloroethane (symmetric), to which a few drops of carbon tetrachloride had been

to believe that the optical behaviour of a Christiansen filter is a matter of geometrical optics, the part of the spectrum at which there is equality of refractive index coming through without deviation, while the rest of the light is diffused as a result of multiple reflections and refractions. Such an explanation of the

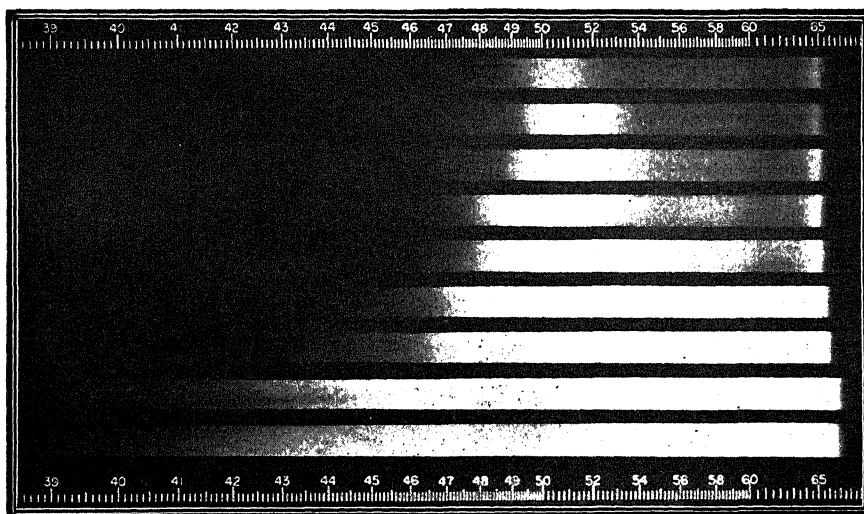


FIG. 4

added. Practically the whole of the spectrum appears in the transmitted light when the thickness of the layer is a millimetre or two. A thickness of nearly a centimetre is necessary before any concentration of intensity in the region of equality of refractive indices of the solid and the liquid becomes noticeable. Even so, the transmission extends to the extreme limit of sensitiveness of the photographic plate in the red, while on the other hand, there is a complete cut-off on the violet side. Very different results are obtained when, instead of tetrachloroethane, either toluene or an acetone-carbon disulphide mixture is employed. These liquids have a much higher dispersive power than potassium chloride.

On a superficial view, one may be tempted

action of the filter is, however, not only inadequate but definitely misleading as can be seen from the facts set out and illustrated in this article. In a paper published recently and referred to above, an attempt has been made to deal with the subject from the standpoint of wave-optics. The expressions developed in that paper for the extinction coefficient of a Christiansen filter afford at least a general explanation of the facts of observation set forth in the present article. It appears not unlikely however that a fresh approach from the standpoint of the electromagnetic theory of light may be necessary to give a more complete account of the observed phenomena.

C. V. RAMAN.
M. R. BHAT.

ASTRONOMICAL AWARD TO PROF. S. CHANDRASEKHAR

THE Gold Medal of Britain's Royal Astronomical Society—the Society's premier award—has this year been awarded to Professor S. Chandrasekhar for his contributions to mathematical astrophysics. The Medal, which is awarded annually for eminent contributions to the study of astronomy, was first awarded in 1824.

Professor Chandrasekhar is a Distinguished Service Professor of Theoretical Astrophysics at the Yerkes Observatory, Wisconsin, U.S.A. He has written a number of important books on astronomy, among them: "An Introduction to the Study of Stellar Structure" (1939), "Principles of Stellar Dynamics" (1942) and "Radiative Transfer", (1950).

EVIDENCE FOR THE EXISTENCE OF VASCULAR LAND PLANTS IN THE CAMBRIAN

K. JACOB, MRS. CHINNA JACOB AND R. N. SHRIVASTAVA
Geological Survey of India

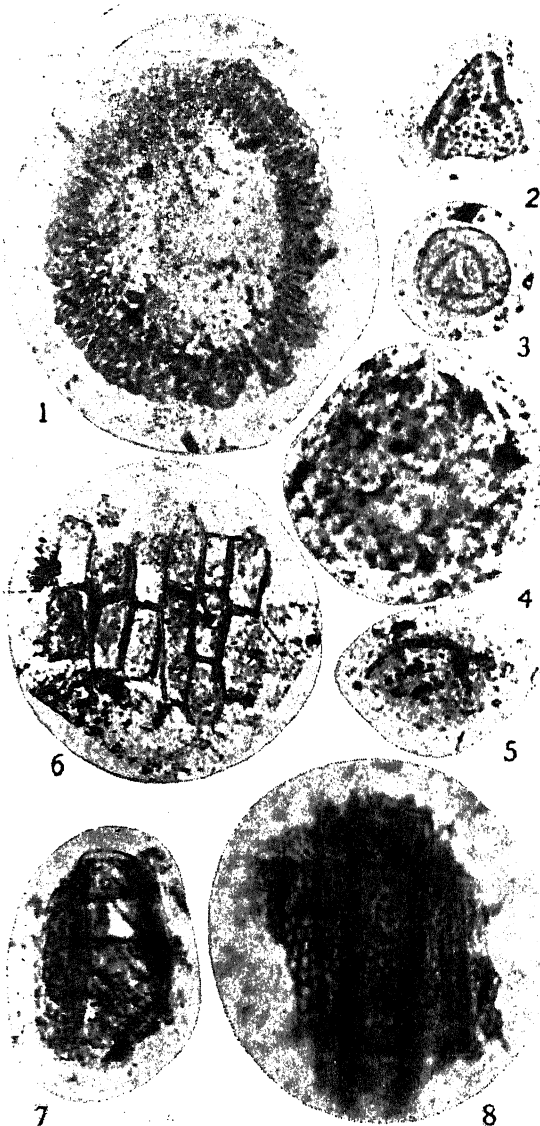
A. K. GHOSH AND A. BOSE in a series of short papers have recorded the presence of spores and woody elements in the Cambrian of the Salt Range^{1,2,3} and Kashmir,⁴ and from the Vin-dhyans.⁵ With a view to verifying some of their findings which had raised some doubts in India, A. K. Ghosh handed over some of his material to us for investigation in the laboratories of the Geological Survey of India. In addition to these samples, some authentic Cambrian material available in the collection of the Geological Survey were also examined by us.

The specimens investigated include the Cambrian *Neobolus* shale from the Salt Range containing well-preserved *Neobolus*, *Redlichia*, etc. (Geological Survey of India, Reg. Nos. K33/591 f, K 17/480), the Middle and Upper Cambrian olive-green, phyllitic shales from the Hundwar Tehsil of Kashmir with *Tonkinella*, ? *Obolus*, etc., present in that horizon (Geological Survey of India, Reg. No. K32/248) and the Upper Cambrian dark grey, fine-grained shale from the Parahio river, Spiti. In addition, a specimen of ? "*Neobolus* shale" from the Salt Range collected by the geologists of the Burmah Oil Co., and kindly handed over to us by A. K. Ghosh was also examined. Ghosh and Bose² have described the organic remains recovered by them from this material.

Samples were treated in hydrofluoric acid and macerated in Schultze's fluid. All possible precautions were taken to avoid contamination in the laboratory.

All the above-mentioned samples examined by us yielded well-preserved spores, tracheids and what appear to be bits of cuticles. On the whole, we support Ghosh's general findings from the Cambrians of India that traces of vascular plants occur in these ancient sediments, but we differ from him in certain details. At least 43 different types of spores were obtained from the different samples examined by us. Some of the organic remains are identical with those found by him.

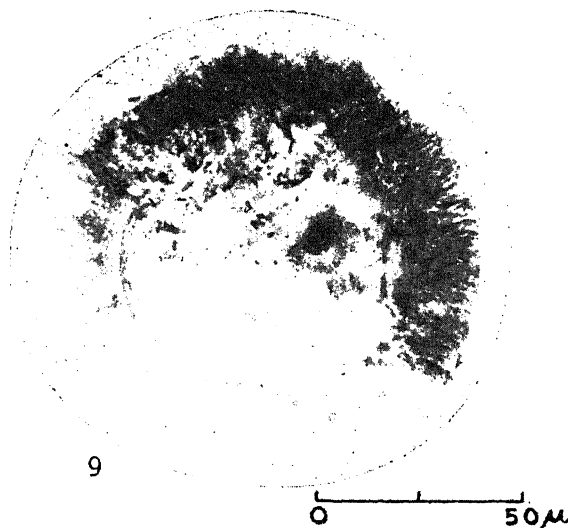
All the spores are cutinised and are light yellow in colour. The shape in the majority is generally round or oval with or without tri-radiate mark. Spores which are triangular in outline with a clear triradiate mark and well-developed sculpture are found only in the ? "*Neobolus* shale" of the Salt Range collected by the Burmah Oil Co. These



FIGS. 1-3.—Spores from the *Neobolus* shale, Salt Range (B.O.C. Coll.).

FIGS. 4, 5.—Spores from the *Neobolus* shale (Cambrian), Salt Range (G.S.I. Coll., K 17/480).

FIGS. 6, 7.—Cuticle (6) and spore (7) from the *Neobolus* shale (Cambrian), Salt Range (G.S.I. Coll., K33/591f).



FIGS. 8, 9.—Woody elements (8) and pollen (9) from the olive-green shale (Cambrian), Hundwar tehsil, Kashmir (G.S.I. Coll., K32/248).

appear to belong to the primitive pteridophytes. Some of them may even be pteridospermous. Only two are figured here (Figs. 2 & 3).

There are much larger spores, round or oval in outline, possessing a central body, more than 50μ in diameter in some cases, and a prominently frilled margin (Figs. 1 & 9). In one or two a triradiate mark is visible. Spores of this general type measure 75μ – 130μ in diameter and are fairly common in the Middle and Upper Cambrian of Kashmir (Fig. 9) and the ? "Neobolus shale" of the Salt Range collected by the Burmah Oil Co. (Fig. 1). At least three distinct types of this group are present in the Kashmir Cambrian sample examined. It is possible that they belong to the Pteridospermæ.

Pollen with two distinct bladders are found in the ? "Neobolus shale" from the Salt Range (B.O.C. Coll.), the Upper Cambrian of Spiti and the Middle and Upper Cambrian of Kashmir. While at least three distinct and well-developed types of this group are recovered from the "Neobolus shale" (B.O.C. Coll.) only two types quite distinct from each other and quite different from any found in the ? "Neobolus shale" (B.O.C. Coll.) occur in the other two localities. Those from the Burmah Oil Co., ? "Neobolus shale" resemble some of the late Palæozoic ? gymnospermous or pteridospermous pollen.

Round or oval spores with faint partition lines simulating a coarse network are found to occur in the Cambrian of Kashmir (37μ diameter) and the Cambrian Neobolus shale (G.S.I. Coll.) of the Salt Range (50μ diameter).

A piece of undoubted plant matter recalls what Reissinger⁹ distantly compares with Equisetalean prothallia from his material of the Lower Cambrian blue clays of Esthonia. Such comparisons with delicate plant matter which have hardly been met with in the fossil state, should be taken with reserve in the absence of convincing evidence.

It is difficult to suggest the affinities of the woody elements (Fig. 8), several fragments of which have been obtained. While most of them are dark yellow in colour with well-developed bordered or simple pits, some appear to be carbonised. The fragments with bordered pits and the simple pitted carbonised bits from the Spiti and Kashmir Cambrians, are indistinguishable from those shown in Pl. IV, Figs. 7, 12 & 13 of the woody elements from the blue clays of the Cambrian of Kunda in Esthonia.⁹ The cuticles are devoid of any stomata in the very fragmentary pieces recovered (Fig. 6).

At least 6 different types of spores from the Cambrian of Spiti, 6 from the Cambrian of Kashmir and 31 from the ? "Neobolus shale" of the Salt Range (twelve in the G.S.I. material and nineteen in the B.O.C. specimen), were obtained in the slides so far examined. The descriptive account of the individual spores will appear in the detailed paper to be published elsewhere. We are inclined to believe that the primitive pteridophytes and the pteridosperms are represented in the Middle and Upper Cambrian sediments examined by us.

The authors would particularly draw the attention of geologists and palæobotanists to the important contributions by Naumova,⁶ Kopeliovitch,⁷ Reissinger^{8,9} and Darrah¹⁰ describing spores of vascular land plants from the Cambrian sediments of Europe.

The general conclusions drawn by Naumova⁶ regarding Cambrian spores are not quite in agreement with our observations regarding the size, shape and sculpture of the spores from the Indian Cambrians. The Indian triletes so far recovered by us vary in size from 5μ – 50μ and the larger frilled spores from 75μ – 130μ . According to Naumova the Lower Cambrian Pre-Baltic spores from Russia are comparatively small in size varying from 15μ – 25μ , exclusively round or oval in outline with simple sculpture and well-developed folds indicating a comparatively thin spore coat. Those described by Reissinger⁹ also generally agree in shape, size and sculpture with the Pre-Baltic spores. The spores from the oil shales of the Kolm in Sweden described by Darrah¹⁰ are somewhat larger in size and are probably all referable to the Bryophyta or

the Pteridophyta. Apparently, the Indian Cambrians show more highly evolved spores of comparatively large size some of them possibly belonging to the Pteridospermæ. Spores of triangular outline are particularly common in the sample of : "Neobolus shale" from the Salt Range collected by the Burmah Oil Co.

The spores from this sample are so well-preserved and so abundant in the slides with several distinct types showing well-developed sculpturing and with quite a few triangular spores that we are somewhat doubtful as to its correct horizon. Further, the spore assemblage even including two-bladder : pollen closely resembling *Pityosporites* with well-developed striations on the body of the spore, also recalls to a great extent those recovered from the Lower Gondwana sediments of the Salt Range (Speckled sandstone—Middle Products beds) and Pali, Rewah.¹¹ The B.O.C. specimen is a fine-grained greenish sandstone with streaks of carbonaceous matter with no Cambrian animal remains preserved to be quite certain of its provenance. For the time being we, therefore, hold this specimen as of doubtful Cambrian age, the spores contained in them showing a late Palæozoic affinity, unless, of course, it turns out that the Cambrian forms were already well developed and persisted right up to the Permian without much modification! This was rather unlikely.

The other Cambrian shales from which spores and tracheids have been recovered by us, are, we are convinced, of Cambrian age. On the whole, we believe that there is sufficient evidence to indicate as Naumova,⁶ Reissinger,^{8,9} Darrah,¹⁰ Ghosh⁴ and Jacob¹² have already pointed out, that the vascular land plants were

in existence even as early as the Cambrian and not entirely unknown in strata older than the Silurian, as generally believed. The spores, tracheids and cuticle, bear out the fact that the vegetable kingdom had already reached this stage of development during the early Cambrian at least, paving the way for animal life on land.

The present short note is mainly intended to emphasise the need for a careful and systematic search of the pre-Silurian sediments for further evidence of traces of vascular land plants, and to determine the history and evolution of the plant kingdom in the remote times represented by the early Palæozoic or even Proterozoic sediments.

We are grateful to Dr. M. S. Krishnan and Dr. J. B. Auden, Geological Survey of India, for their keen interest in the work. We are thankful to Mr. A. K. Ghosh, Bose Research Institute, Calcutta, for kindly giving us a copy of the English translation of Naumova's paper in Russian and to Mr. P. K. Nag for help in taking some of the photographs.

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INDIAN RARE EARTHS FACTORY

THE Indian Rare Earths Ltd., Alwaye, which was formally opened by the Prime Minister, Shri Jawaharlal Nehru, on 24th December, came into being in September 1950, after the deliberations of a Committee set up by the Government of India in July 1949. The Board of Directors consists of: Mr. J. D. Choksi, Dr. H. J. Bhabha, Dr. S. S. Bhatnagar, Mr. K. R. K. Menon, Dr. K. S. Krishnan, and the Chief Secretary and the Finance Secretary of the Government of Travancore-Cochin.

The occurrence of monazite in Travancore-Cochin State was first discovered by the German chemist, C. W. Schomburg, in 1909. This discovery was followed almost immediately by an investigation of the area by the Geological Survey of India. Monazite was first exported to U.K. in the year 1910. When the agreement

between the Government of Travancore and the British firm lapsed, further exports were banned by the Travancore Government.

The factory can process 1,500 tons of monazite sands a year. The sand will be supplied by the Government of Travancore-Cochin. The main products are rare earth chlorides and rare earth carbonates. The plant is capable of producing the entire earth as either chlorides or as carbonate. This is due to the fluctuating nature of the demand for these products. It can produce a maximum of 1,650 tons of chlorides or 1,150 tons of carbonates. Normally it will produce approximately 1,000 tons of chlorides and 450 tons of carbonates. The by-products are between 1,500 to 1,800 tons of crystalline tri-sodium phosphate and 9,000,000 gallons of caustic soda lye in 10 to 12 per cent.

solution. The residue, after all this extraction, when suitably treated, can yield approximately 205 to 228 tons of thorium nitrate, provided all the thorium is converted to nitrate. These figures are variable as the thorium oxide content of monazite is known to vary from 8 to

9.5 per cent. This residue will be treated by a factory being set up by the Atomic Energy Commission for the production of uranium and thorium compounds. This factory will also extract uranium.

PROFESSOR B. B. MUNDKUR—OBITUARY

THE passing away of Professor Balachandra Bhavanishankar Mundkur, Professor of Botany, Poona University, and noted Indian Mycologist on December 13, 1952, will be received with deep regret both in this country and abroad. Prof. Mundkur was born on January 26, 1896 in the village of Mundkur near Mangalore on the West Coast of India in the State of Madras. He was the only son of his father. He matriculated in 1915 and had his early collegiate education at the St. Aloysius College, Mangalore. In 1920 he took his B.A. (Hons.) Degree in Botany and passed out First Class with a Gold Medal from the Presidency College, Madras. For a short period after graduation, he was Agricultural Officer in Bengal and from 1922 to 1928 was Assistant Mycologist in the Cotton Research Scheme at Dharwar from where the bulk of his pioneering published work on the cotton wilt problem appeared. He obtained his Doctor of Philosophy degree from the Iowa State College, Ames, Iowa, in Plant Pathology, working there between 1929-31. On his return to India, Dr. Mundkur was appointed as Assistant Mycologist in the Mycology Division, Indian Agricultural Research Institute, Pusa, Bihar. Indeed, his association with this Institution both at Bihar and New Delhi until 1947 for well over sixteen years marked a period of great mycological activity, and he not only published several scientific papers and monographs on Indian *Synchytrium*, Indian *Phyllosticta*, *Pestalotia* and *Monochaetia* and Indian *Smu's*, but also edited a critical supplement to 'Fungi of India' by Butler and Bisby. He also published a number of papers on Indian Rusts. This period was also significant in that he had developed a small but devoted school of Mycological workers whose critical observations in their various independent capacities later on was marked by the thoroughness with which their training for critical observations was imparted by Dr. Mundkur. Altogether, Dr. Mundkur published a large volume of scientific papers appearing in many journals all over the world, and the

climax was the publication of a text-book entitled "Fungi and Plant Diseases" in 1949. A notable recent publication on the Ustilaginales of India published by the Commonwealth Mycological Institute is to be considered as a landmark in this field.

From 1947 to 1952 he served in an advisory capacity as Deputy Director of Plant Protection, a Department born in the wake of Indian Independence. His pioneering work in this field will long be remembered with gratitude in this country. For a short period of a little over one year, from 1952 till his demise at Poona, he was the first occupant of the newly created Chair of Botany at the Poona University. I recall from one of his personal letters with what a high degree of humility he accepted the post—a very admirable quality in a senior scientist! I also recall with what great enthusiasm he had planned to go to Europe in 1951 on a 'Mycological tour', but that was not to be, since he had already taken ill then. Professor Mundkur was elected in 1950 as President of the Botany Section of the Science Congress Session at Bangalore. Among his other contributions to the scientific community in India are his creative effort in bringing into being the Indian Phytopathological Society and the taking over in its initial stages the editing of its official organ, the *Indian Phytopathology*.

Prof. Mundkur's scientific career was marked by thoroughness and although he was characterised by varying moods and what appeared to be a hypercritical nature, what was most characteristic of the man, as I saw it, was that he had beneath this exterior a genuine interest and ungrudging appreciation of sound scientific work, whichever quarter it came from, and indeed, this feeling had reached such a tempo that he had no time for any one who had not wholly adopted a scientific career as his life's mission. Prof. Mundkur is survived by his wife and two sons, to whom we offer our most sincere sympathy in their loss.

T. S. SADASIVAN.

RESEARCH INFORMATION SERVICE

THE Research Information Service, 53, Nassau Street, New York 38, N.Y., issues periodically bulletins listing translations of patent applications and other scientific literature which are free of charge. The latest Bulletin No. 72 containing eleven pages of abstracts and entitled "Plastics and Synthetic Rubber", contains four sections. Section I is devoted to silicones and related compounds. An interesting example of the reports offered in this section is No. 6083, "Process for Limiting Chain Length and Degree of Cross-Linkage in the Polymerization of Silicone Products" (Siemens-Schuckertwerke, November 1951, \$7.50), which describes methods for manufacturing products with good, easily controllable properties from component mixtures of the starting material without the need for separating mono and di-compounds.

Section II, which pertains to Vinyl and Ethylene Compounds, features a "Process for Manufacturing Polyethylene Shapes" (BASF, May 1951, \$6.00), which enables the manufacture of sheets of any desired thickness, films, trays, gaskets and other shapes that are free of bubbles and are fast to boiling, in addition to titles dealing with stabilization of polyvinyl acetal, emulsion polymerization, and other topics.

Novel processes for producing oil-modified polystyrene resins and styrene copolymers are described in Section III. Section IV, Elastomers, is highlighted by Report 6094, which proposes new fillers for silicone rubber. These are said to yield remarkable increases in the tensile strength of the end products, "Process for Manufacturing Shapes from Natural or Synthetic Rubber and other Elastomers" (Degussa, November 1951, \$6.50). Other Reports in this Section disclose an important new Bayer process based on a di-isocyanate-modified polyester using

glycols as vulcanizing agents (Report 6053, \$65.00) and an Austrian patent for improving the adhesion of synthetic rubber to textiles (Report 6095, \$14.00).

A noteworthy example from Section IV, Cellulose and Related Compounds, is a translation of an invention by Vereinigte Glanzstoff-Fabriken which makes it possible to obtain from viscose a leather-like material of considerably higher abrasion resistance than natural chamois and equal absorbency (Report 6097, November 1951, \$21.50: "Process and Apparatus for the Manufacture of a Leather Substitute from Viscose"). A solvent and plasticizer for acrylonitrile polymer which surpasses known agents in stability, solvency, and physical properties and offers the advantage of a low dissolving or gelatinizing temperature is described in Report 6100, which is listed under Section VI, Acrylics, Phenolics and Polyesters (Roehm & Haas, December 1951, \$6.50). Extremely valuable data are found, too, in the last section of Bulletin 72 entitled "Miscellaneous Processes". In first place we find an abstract of a Dynamit A.G. patent application dated January 1952 on a process which yields bubble-free, transparent casting resins representing polyaddition products of very high storage stability (Report 6102, \$27.00).

The selection comprises altogether 44 Reports, all of which are abstracted and listed with patent application number and other pertinent bibliographic information as well as prices.

Bulletin No. 71 entitled "Inorganic Chemicals" consists also of 4 sections—Sulphur and Sulphur Compounds—Chlorine and Chlorine Compounds—Miscellaneous manufacturing processes and articles from Russian Scientific Journals.

ELECTRONIC WEATHER FORECASTER

A NEW calculating machine, specially designed to deal with problems of accurate and rapid weather forecasting, has recently been developed at the Institute for Advanced Study, Princeton, under the direction of Prof. J. von Neumann.

Nicknamed "Maniac", the machine contains about 2,000 radio tubes and completes computations with greater speed than any previously built calculating machine.

Simultaneously, the Institute for Advanced Study is modifying the techniques of weather

forecasting in order to be able to use the mathematical potentialities of the new machine. Weather forecasters, for example, have been using equations which comprise great air masses; but these masses have been dealt with as isolated units. The new equations devised for "Maniac" deal with much greater units. They comprise the whole atmosphere up to an altitude of 12 miles, and deal with this air mass as if it were built up of imaginary "boxes", each with a volume of 240 cubic miles.

LETTERS TO THE EDITOR

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MICROTONAL VARIATIONS IN FREQUENCIES IN KARNATIC MUSIC-II

The present note gives the results of measurements made on the oscillograph records 12, 13 and 15 which confirm, in a general way, my previous observations.¹ The measurements were made with a Hilger travelling microscope reading to one-thousandth of a millimetre. The procedure was to take the scale readings for every five waves, first on the raga curve and then on the curve for the time-base-vibrator and compare the frequencies from the values of the wavelength. This ensured elimination of errors due to mechanical defects involved in the process of recording, and also enabled one to know the exact instant when changes in the frequency took place and the duration for which such changes persisted.

The results are shown by the plot of these curves 12, 13, and 15. They are deduced from

a second test of records taken after retuning the violin. (To understand the curves, please read from right to left).

No. 12, Begada 'Da' (Repeat of Record No. 5) was played on the Pa string, the frequency of the retuned open string having been found as 604 ± 1.5 . The continuous curve represents the variations in this note, Da. It starts with 603 c/s., rises to 691; drops to 661, rises again to 686 and finally drops to 603. At the time of the experiment, it was noted "phrase probably repeated twice". This is clearly confirmed by the second rise from 603 to 664 when the camera was shut off. The variation in Da is from R.F. 5/3 to 12/7, (689 c/s., Pa being 3/2), confirming the existence of the quarter-tone 36/35 in Karnatic Music.

Curve 13 was the play of Saveri 'Ri'. This was a repeat of Record 7, which was not originally measured owing to some extraneous dis-

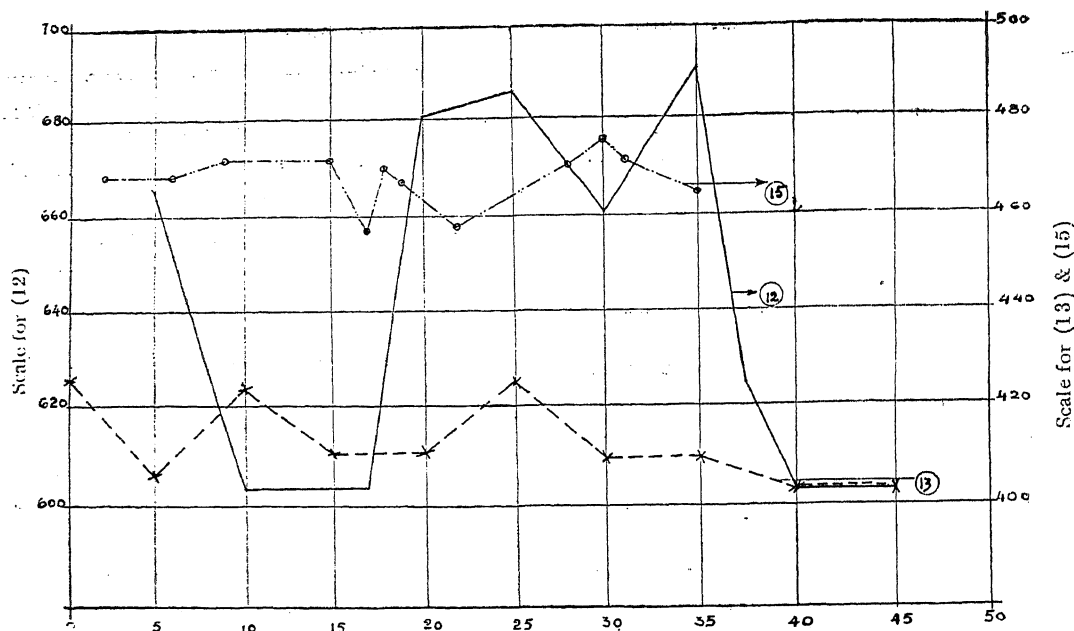


FIG. 1. Frequency variation in Karnatic Music notes : (12) *Begada Da* ; (13) *Saveri Ri* ; (15) *Thodi Ga*.

turbance which had produced violent distortions as noticed in the Report of the Director, National Physical Laboratory, London. This note was played on the *Sa* string and the curve should be read against the scale 400 to 480. It starts at 403 c/s., rises up to 411, shoots up to 425, drops to 411 and goes up to 426 twice. This fairly confirms the variation (*gamaka*) of *Ri*, from R.F. 25/24 to 16/15 (430 c/s.), suggested by analogy in reference to the variation in *Saveri 'Da'*.¹

Record 15 was the first play of *Thodi 'Ga'*, also played on *Sa* string. It is apparent from the plotted curve (15) that the note is in *gamaka*, varying from 457 to 477 c/s.; i.e., from a point above R.F. 10/9 to R.F. 7/6 (470 c/s.), and a little beyond, *Sa* being 1; the *veena* technique of the note would lead us to postulate it as from R.F. 10/9 to 7/6.

The records were analysed for me on the new basis, in the Physics Laboratory of the Mahakoshal Mahavidyalaya, Jabalpur.

Mylapore, Madras,

C. S. AYYAR.

January 5, 1953.

BROCKEN BOWS

THE Brocken bows or anti-coronas are spectrum coloured rings seen around the shadow of one's head in natural clouds, the sun being at the back. These rings are formed by the backward selective scattering of light of different wavelengths by the water-drops in the cloud. Mierdel¹ was the first to observe this phenomenon in artificial clouds by the use of a periscope. His results were used by Hulst² in his theoretical study of the formation of anti-coronas.

We have been able to reproduce this phenomenon in the laboratory in the following manner. A large cloud chamber (flask) of about 20-litre capacity was illuminated by a strong beam of white light. A small convex mirror was introduced in the path of the beam of light between the source and the cloud chamber, with its reflecting surface towards the flask. The mirror was kept inclined at 45° to the incident beam, so that a diminished image of the flask could be seen in the mirror from a transverse direction. When a cloud of a suitable size was formed in the flask by sudden expansion, the image of the cloud in the convex mirror was found to consist of a dark shadow of the mirror, surrounded by a series of coloured rings. Very often two or three orders of rings of same wavelength could be observed in a given cloud.

1. *Curr. Sci.*, Aug. 1949, 18, No. 8, p. 272 *et seq.*, and "Grammar of South Indian (Karnati.) Music" (Second Edition, 1951), by C. S. Ayyar.

The first or second order rings are often obscured by the shadow especially for clouds of drops having radii greater than 3.5μ .

The angular apertures of Brocken rings (anti-coronas) of a given colour were determined by a sextant and the necessary correction due to the curvature of the convex mirror in which the rings are observed, was made. The radius of the drops in a cloud was determined by observing the size of corona dark rings, seen in a cloud, when light from a strong monochromatic source (sodium lamp) passes through it.³ A few typical results for the first order Brocken rings of red colour, which were seen outside the shadow, are given below in Table I.

TABLE I
(Experimental results)

| a in μ | α | θ | $\alpha \sin \theta$ |
|--------------|----------|---------------|----------------------|
| 2.68 | 24.67 | $6^\circ 1'$ | 2.584 |
| 2.82 | 25.90 | $5^\circ 57'$ | 2.686 |
| 3.05 | 28.05 | $4^\circ 56'$ | 2.414 |
| 3.36 | 30.90 | $5^\circ 11'$ | 2.793 |
| 3.43 | 31.50 | $4^\circ 11'$ | 2.298 |
| | | mean | 2.555 |

TABLE II
(Theoretical results)

| a' in μ | α' | θ' | $\alpha' \sin \theta'$ |
|---------------|-----------|---------------|------------------------|
| 2.63 | 24 | $6^\circ 30'$ | 2.717 |
| 2.84 | 26 | 6° | 2.717 |
| 3.07 | 28 | $5^\circ 30'$ | 2.684 |
| 3.40 | 31 | 5° | 2.703 |
| 3.51 | 32 | $4^\circ 50'$ | 2.698 |
| | | mean | 2.704 |

[a =radius of drops in microns, $\alpha=2\pi a/\lambda$, λ being the wave-length and is taken as 6800 A.U. in these observations, θ =angular aperture of the radius of the Brocken rings. The dashed letters in Table II refer to the theoretical values of the same quantities.]

The anti-coronas could be explained on the basis of Mie's theory⁴ of scattering of light by spherical particles. The determinations of the intensity functions for different angles and for different drop sizes of proportionally large radii, involve very extensive and laborious calculations. Rudy⁵ has, however, shown that for such large-sized drops, the diffraction and the scattering theories give nearly identical results. Hence the intensity values of light diffracted by water-drops in different backward directions

and different drop sizes were evaluated on the basis of Ruedy's formula. From these results, the angles of the first maxima of light intensity of a given wavelength are determined. These values are given in Table II.

It can be seen that the observed angles for the Brocken rings are in fairly good agreement with the theoretical values. The last column indicates that the theoretical values of $\alpha \sin \theta$ is nearly constant, and the experimental ones also appear to be nearly so. The deviations in the observed values of $\alpha \sin \theta$ from the theoretical values may be due to small errors of measurement. Assuming the theory as correct, we find that $\alpha \sin \theta = 2.704$.

This formula therefore provides a measure of the radius of the drops in a cloud and is similar to the one used in corona method. It may be noted that Hulst² arrived at the conclusion that the diffraction theory is not adequate to explain the changes in the size of the Brocken rings with the variation in the size of the drops. This conclusion may be due to insufficient or uncertain data of the previous observers.

A detailed account of this work will be published elsewhere in due course.

Gujarat College,
Ahmedabad,
September 9, 1952.

Y. G. NAIK,
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ULTRA-VIOLET ABSORPTION SPECTRA OF HALOGENATED TOLUENES

IN continuation of the previous work on the absorption spectrum of *p*-chloro-toluene¹ the author has photographed the absorption spectra of *o*- and *m*-chloro toluenes and ortho-bromo-toluene in vapour state. The spectra of ortho-chloro and bromo-toluenes have been found to possess sharper band heads than the spectrum of *m*-chloro toluene. The strong bands located at ν 36877, 36615 and 34846 are taken as 0-0 bands for *o*-chloro, meta-chloro and ortho-bromo-toluenes respectively. The observed ground and excited state frequencies for the three molecules are as follows:

Ortho-chloro-toluene

| ν'' | 161, | 245, | 362, | 677, | 749, | 808 |
|---------|--------|--------|--------|--------|--------|-------|
| | (162), | (247), | (362), | (675), | (745), | (808) |
| ν' | 484, | 644, | 769, | 962, | 1069, | 1182 |

Meta-chloro-toluene

| | | | | | |
|---|--------|--------|------|------|------|
| " | 182, | 236 | | | |
| " | (187), | (231), | | | |
| " | 245, | 454, | 785, | 962, | 1205 |

Ortho-bromo-toluene

| | | | | | |
|---|--------|--------|-------|------|------------|
| " | 152, | 239, | 313 | | |
| " | (152), | (236), | (297) | | |
| " | 478, | 603, | 771, | 960, | 1014, 1181 |

The values given in the brackets are Raman frequencies taken from Megat.²

Further details of the assignments will be published elsewhere.

Andhra University, G. VISWANATH.
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December 15, 1952.

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ESTIMATION OF THIOSEMICARBAZONES USED IN THE CHEMOTHERAPY OF TUBERCULOSIS

THIOSEMICARBAZONES of some aromatic aldehydes have been shown to be highly active *in vitro* and *in vivo* against tuberculosis by Domagk *et al.*,¹ Domagk² and Hoggarth *et al.*³ An attempt has been made in this paper to identify and estimate this group of drugs in pharmaceutical preparations. One of these compounds, P. succinyl-amino-benzaldehyde, thiosemicarbazone sodium hydrate was sent to this laboratory for identification and estimation. Heilborn, *et al.*,⁴ have shown that these compounds have the characteristic property of absorbing ultra-violet light. The region in which there is maximum absorption by these drugs is approximately the same as for vitamin A (320 mμ). Employing a special combined filter of liquid and glass which has been used in this laboratory for the estimation of vitamin A with the Lumetron Photometer 402 E.F., the absorption was found to be very much more than for the other thiosemicarbazones. On account of this very high absorption, extremely high dilutions of the drug have to be used for its estimation.

A graph connecting the concentrations with the corresponding optical densities was drawn after measuring the percentage transmissions of varying concentrations of the drug. This was found to be a straight line in the range of concentrations studied (i.e., 1 mg. in 10,000 c.c. to 10 mg. in 10,000 c.c.). The extinction coefficient is given by the following equation.

$$E_{320\text{ m}\mu}^{1\%} = 2,000.$$

In view of the high extinction coefficient, this property of absorption can be employed for the estimation of the drug in very small quantities, occurring in body fluids after the administration of the drug.

The authors' thanks are due to Dr. M. D. Chakravarti, Director of the Laboratory, for his kind interest in the work.

Central Drugs Laboratory, N. K. IYENGAR.
Calcutta-12, H. K. BISWAS.
November 7, 1952. S. DUTTA.*

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* Deputed by the Bhopal Government for training.

ATMOSPHERIC OXIDATION OF IODIDE—USE OF AMMONIUM MOLYBDATE AS CATALYST

THE reaction, $4\text{HI} + \text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{I}_2$, is extremely slow in neutral medium and becomes more pronounced at higher hydrogen-ion concentrations. Ammonium molybdate was found to catalyse^{1,2} many reactions involving the oxidation of iodide ion. Now, the above reaction is also shown to be catalysed. The reduction of ammonium molybdate by iodide at high acidities was also known.

In the present work, 100 c.c. of HCl ranging between 0.1N and 6N and 10 c.c. of 10% KI solution were taken in glass-stoppered bottles and the atmospheric oxidation was studied (a) without and (b) with 10 drops of 10% aqueous solution of ammonium molybdate and some illustrative results are given in Table I. Again, in the same concentration range of HCl the reaction between ammonium molybdate (between 5 drops and 10 c.c.) and 10 c.c. of 10% KI solution was studied out of contact with air and in an inert carbon dioxide atmosphere. The liberated iodine under different conditions was titrated against standard 0.02N sodium thiosulphate solution from a micro-burette.

Whilst the amount of iodine liberated in an inert atmosphere is appreciable at larger molybdate and acid concentrations, it is negligibly small under the conditions where the catalytic aspect was studied. The results in the table show a definite positive catalysis at low acid

| in hrs. | 1 | | 2 | | 3 | | 4 | |
|-----------------------------------------------|------|------|------|------|------|------|------|------|
| Vol. of $a_2S_2O_3 \times 10$ (in c.c.) | (a) | (b) | (a) | (b) | (a) | (b) | (a) | (b) |
| .. | 2.0 | 4.0 | 4.0 | 6.0 | 5.5 | 8.0 | 7.5 | 10.0 |
| .. | 4.0 | 5.0 | 7.5 | 9.0 | 12.0 | 14.0 | 16.0 | 17.5 |
| .. | 6.0 | 6.0 | 8.5 | 8.5 | 13.5 | 13.5 | 16.0 | 16.0 |
| .. | 8.0 | 8.3 | 12.5 | 12.8 | 19.0 | 19.6 | .. | .. |
| .. | 12.5 | 12.7 | 19.0 | 19.5 | 26.0 | 26.5 | .. | .. |

tion but the same was not observed N. This may, perhaps, be due to the and cationic behaviour of Mo on either the iso-electric point.

anks are due to Prof. B. Prasad for his ice in the work.

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r 11, 1952.

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ELECTROPHORETIC PATTERN OF POLYVALENT ANTI-SNAKE-VENOM SERUM

γ proteins of horse serum are now
known to reside in a fraction pos-
sessing electrophoretic mobility between the
serum gamma-globulins and the lipid-
globulins. This fraction, however, has
been designated differently by different workers
from time to time. Van der Scheer and Wyc-
hed called it the T-Component while studying
anti-toxic serum. Kekwick and Record²
called it beta-2-component while studying
a anti-toxic serum, and Deutsch *et al.*,³
designated it as gamma-1-globulin to distin-
guish it from the normal serum gamma-2-

The same anti-body component has,
however, been given different names from different

workers. Nevertheless, the electrophoretic patterns of
different anti-toxic sera indicated clearly
that after hyper-immunization of horses with
toxins a new component showed it-
self distinctly as a distinct peak in the electro-
phoretic pattern. We prepared a polyvalent anti-
snake-venom serum in horses with simultane-

ous injections of a mixture of venoms of all
the four poisonous snakes of India according to
the method of Hazra.⁴ We were interested to
find out whether such a polyvalent anti-venene
would show an electrophoretic pattern similar
to that shown by the common anti-toxic sera,
or would be different.

We have, therefore, photographed, the electro-
phoretic patterns of (i) normal horse serum,
(ii) natural polyvalent anti-snake-venom horse
serum, (iii) diphtheria anti-toxic horse serum
pseudo-globulin fraction, and (iv) polyvalent
anti-snake-venom horse serum pseudo-globulin
fraction in our Adam-Hilger Electrophoretic
apparatus. Samples (iii) and (iv) were pre-
pared by ammonium sulphate fractionation
procedure of Gibson⁵ as modified by Murdick.⁶
These are shown in Figs. 1-4.

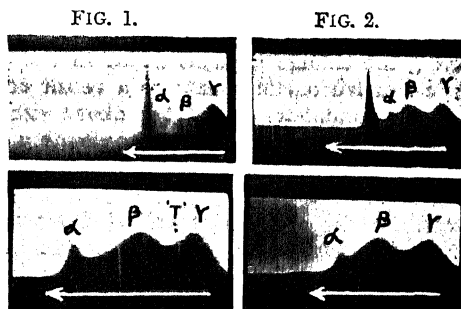


FIG. 1. Normal horse serum.

FIG. 2. Natural polyvalent anti-snake-venom horse serum.

FIG. 3. Diphtheria anti-toxic horse serum pseudo globulin fraction.

FIG. 4. Polyvalent anti-snake-venom horse serum pseudoglobulin fraction.

The pattern of the polyvalent anti-snake-venom serum differed from those of both the normal serum and the diphtheria anti-toxic

serum. There was in the anti-snake-venom serum considerable increase in the beta-component, but no distinct peak could be found separate either from the beta- or from the gamma-peak. The diphtheria anti-toxic pseudoglobulin fraction, on the other hand, showed a small but distinct peak associated with the gamma-globulin component. The polyvalent anti-snake-venom horse serum, thus, differed from the anti-toxic horse serum.

Dept. of Anti-toxins and Sera, D. C. LAHIRI.
Haffkine Institute, S. S. RAO.
Bombay-12,
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PHAGOCYtic RESPONSE IN GUINEA PIGS TO CERTAIN INDIGENOUS MEDICINAL PLANT EXTRACTS

In the *in vitro* experiments adopted for the purpose of studying phagocytic response of human blood leucocytes to *Micrococcus citreus* in presence of the aqueous extracts of the leaves of *Murraya koenigii* and the nuts of *Areca catechu*, it was reported¹ that whereas the former enhanced the phagocytic activity, the latter had a depressing effect. In this paper are presented some of the results obtained *in vivo* on studying the change brought about in the phagocytic and leucocytic counts as a result of the parenteral administration of the above extracts to female guinea-pigs of approximately the same age and weight, and fed on a uniform standardised diet.

Blood for the study was collected from the ear of the animal prior to and after the intramuscular administration of the extracts tested and every time an untreated animal was kept as control. For the total leucocyte count the pipette was filled with blood directly from the ear lobe. Smears for the differential count (made on 300 leucocytes) were also made from the untreated blood; for the phagocytic count, however, the blood was collected in citrate (final citrate concentration in blood being 0.125 M.).

In Table I are presented the results obtained on administration of 1 ml. every day for 5 consecutive days of a 20% aqueous extract (cold,

48 hr. extraction) of the leaves of *Murraya koenigii* to the test animal. The animals were also tested a week after the injections were stopped, i.e., on the 14th day after the commencement of the injections.

TABLE I

| Animal | Time of test | Leucocytes per cmm. | Polymorpho-nuclears % | Mononuclears % | Phagocytic index | % Reacted leucocytes |
|---------|--------------------------------------------------------|---------------------|-----------------------|----------------|------------------|----------------------|
| A | | | | | | |
| Test | Initial | 11,200 | 25.3 | 74.7 | 10 | 65 |
| Control | .. | 12,600 | 10.0 | 90.0 | 8 | 86 |
| Test | Immediately after 5 injections | 9,660 | 28.0 | 72.0 | 27 | 100 |
| Control | .. | 13,420 | 14.0 | 86.0 | 12 | 89 |
| Test | 8 days after stopping injections | 8,300 | 28.0 | 72.0 | 2 | 33 |
| Control | .. | 9,200 | 7.0 | 93.0 | 5 | 78 |
| B | | | | | | |
| Test | Initial | 10,740 | 20.3 | 79.7 | 4 | 55 |
| Control | .. | 12,600 | 10.0 | 90.0 | 8 | 86 |
| Test | Immediately after first 5 injections | 6,120 | 41.0 | 59.0 | 39 | 99 |
| Control | .. | 13,420 | 14.0 | 86.0 | 12 | 89 |
| Test | Immediately after rest period and another 5 injections | 20,800 | 40.3 | 59.7 | 6 | 75 |
| Control | .. | 9,200 | 7.0 | 93.0 | 5 | 78 |

It will be noticed from the results presented above that the *M. koenigii* leaf extract can not only raise considerably the phagocytic index but results in mobilising a greater number of leucocytes to take part in phagocytosis. This beneficial effect, however, does not seem to last long as the tests made on the 14th would indicate. It may also be noted that the variations in the total and differential leucocytic counts were not very appreciable in both the test and control animals.

The results obtained on injecting the test animal with 1 ml. every day for 5 consecutive days of a 10% aqueous extract of the nut of *Areca catechu* (cold, 48 hr. extraction) are presented in Table IB. The phagocytic response of the same test animal was again studied after a 2-day rest period followed by the dose, specified above, for 5 more consecutive days.

It is interesting to note that the overall favourable influence of the *Areca* nut extract in the phagocytic reaction of the test animal is accompanied by a change in the total and differential counts and that this change consists of a decrease in the total and an increase in polymorphonuclears present. When, however,

treatment with the Areca nut was continued on the same animal after a brief rest period, the phagocytic index had fallen by 85% of that recorded after the initial 5-day treatment. Furthermore, marked leucocytosis in the test animal was evidenced at the end of this period even though the normal range observed in guinea-pigs may be as variable a figure as between 5,000-23,000 leucocytes per cmm.² Unlike the unfavourable effect exerted by Areca nut extracts on human leucocytes,¹ there was absolutely no distortion of the guinea-pig leucocytes, nor, for that matter, were any toxic effects apparent in the treated animal, contrary to what was expected as a result of the *in vitro* studies made with human leucocytes.

Pathological Laboratories, RAJUL BROKER.
Sir P. Mehta Road, K. T. GAJJAR.
and
St. Xavier's College, Bombay, J. V. BHAT.
November 12, 1952.

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m-CHLORO PHENYL CYANAMIDE

THE characteristic property of cyanamide and substituted cyanamides is the ease with which they are found to polymerise. Cyanamide polymerises to dicyandiamide, with very great ease in acid or alkaline solution, but not in alcoholic or neutral media. Substituted cyanamides also polymerise under varied conditions. The introduction of positive groups into the molecule of cyanamide hastens polymerisation.¹ The present work was undertaken to study the chemistry of *m*-chloro phenyl cyanamide in the light of the above discussion.

m-chloro phenyl cyanamide was prepared by desulfurising *m*-chloro phenyl thiourea, with lead acetate in alkaline medium and the product was separated by acidifying it with acetic acid in cold.² Desulfurisation of *m*-Cl.C₆H₄.NH.CS.NH₂ with NaBrO₃ or NaIO₃ according to the method of Capps and Dehn³ gave very poor yields. It was also obtained in quantitative yields by a modification of Pierron method.⁴

It is a colourless, needle-shaped, crystalline solid, insoluble in H₂O, readily soluble in EtOH, Et₂O, and C₆H₆. It was recrystallised from benzene. It melts at 89.5° (uncorrected). It forms the hydrochloride, *m*-Cl.C₆H₄.NH.CN.2HCl. In neutral medium it does not suffer any hydrolysis. In alkaline medium, it hydrolyses upto

15.94%. In acid medium the substituted urea is formed. With mercuric chloride it gives *m*-Cl.C₆H₄.NH.CN.2HgCl₂. All attempts to prepare the nitroso derivative have failed. It has been estimated as its silver salt in the presence of acetic acid.

The para isomer of this has been studied by Sahasrabudhey and Krall.¹

Further work on this compound is in progress and full details will be published elsewhere.

The authors' thanks are due to Prof. M. L. Schroff for his keen interest in the work and for the facilities given.

Chemical Laboratories, K. S. SRINIVAS.
Birla College, Pilani, R. D. GUPTA.
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DOUBLE BETA DECAY OF Te¹³⁰ AND Se⁸²

INGHRAM AND REYNOLDS¹ found that xenon from tellurium ore was richer in Xe¹³⁰ than that obtained from atmosphere. They attributed this isotopic abundance to the double beta decay of Te¹³⁰. Fireman² also reported the results of a rather difficult β -coincidence counting experiment on the decay of Sn¹²⁴ to Te¹²⁴ by simultaneous emission of two negative beta particles with a half life between 4×10^{15} and 9×10^{15} years. Reinvestigating the above, Fireman and Schwarzer³ reported, rather dubiously, a much longer half life for the process than the one reported earlier. However, they were not sure whether their experiment confirmed the presence of double beta decay of Sn¹²⁴.

With a view to decide whether Te¹³⁰ decays by the double beta decay process or in steps,

$$\left[\text{Te}^{130} \xrightarrow{\beta^-} \text{I}^{130} \xrightarrow{\beta^-} \text{Xe}^{130} \right]$$
 the first step having a long half life, five pounds of pure tellurium was converted to the water-soluble salt and 20 mg. of iodine and 100 mg. of bromine co-precipitated in it as the silver salt. After removal of bromine, iodine was deposited as AgI and measured in a suitable end-window G-M Counter.

A similar experiment was repeated with 5 lb. of selenium. In this case 20 mg. bromine and

100 mg. iodine were co-precipitated and bromine recovered by digesting the silver halides with potassium dichromate and sulphuric acid. The silver bromide deposited on a plate was measured as above.

In both cases the result was negative, the increase in the number of counts, if any, being well within the statistical fluctuations of the background. It is therefore concluded that either the half life of $\text{Te}^{130} \rightarrow \text{I}^{130}$ and $\text{Se}^{82} \rightarrow \text{Br}^{82}$ is more than 10^{17} years or that they decay by simultaneous emission of two β particles. A detailed report on the detection of double beta decay in Te^{130} will be published elsewhere.

The author is indebted to Prof. G. T. Seaborg for suggesting this experiment which was carried out under his guidance.

Dept. of Chemistry, HARI D. SHARMA.
University of California,
November 26, 1952.

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THE REACTION BETWEEN HNO_2 AND HI

ADOLF ECKSTADT¹ attempted in 1901 a study of the kinetics of the reaction between nitrous acid and hydrogen iodide. His observation was that the reaction took place very rapidly at first but soon slackened. Work done by us has confirmed the above observation.

The initial rapidity of the reaction and a subsequent slackening of its rate *inter alia* made us investigate the possibility of existence of chain mechanism in this reaction.

At concentrations of N/50 NaNO_2 and KI with an excess of N/4 sulphuric acid it was possible to measure the reaction from the second minute onwards until which time it was immeasurably fast.

Coating the vessel with paraffin wax neither retarded nor accelerated the reaction. Titania and silica also had no effect on the reaction. With acetone, ethyl alcohol, d-mannitol, d-glucose, glycerol, vanillin, benzaldehyde, chloral hydrate, manganous sulphate, sodium chloride, and potassium chloride there was no effect on the rate of the reaction. With hydroquinone there was the difficulty of interference due to the formation of an intermediate compound and hence the result was inconclusive. With resorcinol, a permanent red colour developed and so

it vitiated correct determination of the end point. But qualitatively there was no marked retardation in the rate of the reaction as could be seen visually. Potassium chlorate had a slight accelerating effect on the rate of the reaction.

The compounds sodium acetate, sodium citrate, potassium oxalate, ammonium oxalate and potassium tartrate had a very marked retarding effect on the rate of the reaction depending on the amounts added, even with N/10 solutions of NaNO_2 and KI in presence of sulphuric acid of concentrations ranging from N/10 to 6 normal and the rate of the reaction could be measured.

Taking the above observations together with others pertaining to the rate of reaction, yet to be published, there is ample evidence to show that there is no chain mechanism in this reaction. On the other hand there is a positive evidence that the uniformity of the rate of the reaction and its dependence on the amount of the alkali salts of weak organic acids present is due simply to the buffer action of those salts in excess acid.

A fuller study of the chemical kinetics of this acid catalysed reaction is being continued and details will be published elsewhere.

I thank Dr. C. V. Suryanarayana for his valuable guidance.

Dept. of Chemistry, S. SAMBASIVAN.
Annamalai University, Annamalai Nagar,
December 17, 1952.

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ESSENTIAL OIL OF *SESELI INDICUM* W. & A.

Seseli indicum, W. & A., (Sans. Vana-yamani) belongs to the N.O. Umbelliferae. The use of this plant is mentioned in the indigenous systems of medicine for several purposes.^{1,2} The only work on its chemical investigation seems to be the isolation of the three crystalline substances Seselin, Bergaptene and Isopimpinellin from its fruits by Bose and Guha³ and Spath and co-workers.⁴ In the present study, the nature and composition of its essential oil was investigated. The oil (average yield 2.5%), obtained by steam distillation of the finely powdered dry seeds of this plant, is limpid and almost colourless (developing a slightly yellowish shade on keeping or heating) having an aromatic odour and clove-like taste. It is a

thin oil, acidic in nature, and showing d_{40}^{20} 0.8905; n_D^{32} + 34.7; n_D^{32} 1.48214; Acid value 3.1; Ester value 30.0; Sap. value 33.1; and Sap. value after acetylation 64.6. Other physico-chemical properties of the oil have been studied and fractionation effected at reduced pressure. A study of its composition reveals that it consists of 45-50% terpenes (mainly limonene) besides an appreciable quantity of sesquiterpenes and sesquiterpene alcohols. The presence of some other alcohols and esters is also indicated. Acids (about 2%) and lactonic and phenolic bodies (1.5%) have been found to be present in it. Further, on hydrolysis by alcoholic caustic potash other acids have been isolated from the essential oil. Work is in progress and the details will appear in due course.

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December 17, 1952.

filter-paper and neutralised with drops of acidulated water. It is then irrigated with upper grades of alcohol, starting with lower strength, and stained with eosin in 90 per cent. alcohol, the excess being removed with a filter-paper. The material is then cleared in clove oil and mounted in Canada balsam. The whole operation is done under the low power of a stereoscopic binocular.

This work was carried out in the Zoological Laboratory, University of Calcutta, under the guidance of Shri D. Mukerji to whom I am thankful.

Forest Research Inst., P. SEN SARMA.
Dehra Dun,
July 29, 1952.

PROPAGATION OF THREE VARIETIES (HORTI) OF PRUNUS SPECIES BY STEM CUTTINGS

ALTHOUGH stem cuttings of inferior varieties of plums root easily,¹⁻⁵ the varieties Early round, Howe and Kelsey have not been reported to lend themselves to this method of propagation. The author, therefore, tried to propagate them by cuttings with the help of growth substances to introduce a quick and easier method of propagation.

Cuttings, nine inches long, were taken from dormant shoots of the varieties mentioned above. Shoots of medium vigour were used as the vigorous ones are considered to be less desirable. 6. The cuttings were treated with 10, 20 and 30 ppm. solutions of Indole butyric acid for 24 hours. The untreated cuttings were dipped in tap water for similar duration. They were washed with tap water after treatment, and planted in sand with two-third of the total length under sand. The pots were watered regularly.

Formation of roots was observed 14, 18 and 23 weeks after planting in Early round, Howe and Kelsey respectively. All the treated as well as untreated cuttings produced callus which was more developed in the former. The percentage of cuttings that struck roots increased with the concentrations of Indole butyric acid, being lowest in 10 ppm. and highest in 30 ppm., 66, 68 and 22 per cent. respectively, in Early round, Howe and Kelsey varieties. Very small rootlets (3 mm. long) were observed in two untreated cuttings of Early round. These failed to elongate further. The treated cuttings which had developed roots showed vigorous shoot formation and the leaves on such roots were more numerous and well developed.

EASY TECHNIQUE OF DISSECTING THE MOUTH-PARTS OF SUCKING-LICE (INSECTA : ANOPLURA)

THE mouth-parts of sucking-lice, which consist of a few rod-shaped structures contained in a membranous sheath, have evoked considerable morphological interest since long. They, however, present considerable technical difficulty in dissection, partly because of their minute size and partly because of the fact that as the sheath is ruptured, the internal rods float away and escape.

I found the following method very successful with the cow louse, *Linognathus vituli* (Linn.): The insect is placed on a slide in a drop of normal saline. Incision is made on the ventrolateral borders of the head with a sharp needle. The dorsal integument is then removed from the head with a pair of fine forceps. The membranous sac, with the contained piercing rods, floats out. The sac is then taken out, placed on another slide (whose surface was previously coated with Mayer's albumen) and kept aside for an hour or two until it is fully dried up. A drop of 10 per cent. KOH solution in water is then added. After the dissolution of the soft tissues, which takes a quarter to half an hour, the excess KOH is removed by means of a

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Grateful thanks are due to Dr. L. B. Singh for his continued interest in the work and many helpful suggestions.

Fruit Research Station, N. N. DIKSHIT.
Saharanpur, U.P., India,
July 31, 1952.

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BLISTER LEAF-GALLS OF MANGO AND THEIR CONTROL

THE present investigations were primarily undertaken to study the seasonal history of the pest and to work out suitable remedial measures to control the pest.

Initial infestation is noticed on the new growth during June-July. The Cecidomyiid flies, *Allasomyia tenuispatha* (Kieff), and the minute black wasps belonging to Cynopid family are mainly responsible for the numerous gall formations on the leaf. The infested leaf ultimately turns fibrous and brittle, and presents a very rough surface. If very tender leaves are infested they become crinkled and the entire shoot presents a very characteristic appearance. A single gall is multi-cellular, slightly raised into small hemispherical irruption with a dark crater in the apex, and measures at the base about 0.2 cm. The insects oviposit on the very tender leaves just after their emergence. The galls are generally observed on the fourth day in the form of small minute dark spots which consequently develop into galls in the course of 8-10 days. These studies were made in the laboratory by artificial liberation of the insects on the new mango growth under cage conditions. The observations were also confirmed in the field. The emergence of gall insects was closely related with sharp fluctuations in the atmospheric temperatures. The emergence of the pest invariably coincided with the new growth on the host plants, so that the pest always found favourable conditions for its multiplication. The total life-cycle of the gall insects varied from 180 to 200 days between the months of March-July. Only one adult insect emerged from a single gall.

The older infested shoots on the plant, of the previous season, provided the source of new infection on the plant. However, it was observed that the insects were also capable of migration to the neighbouring plants.

Out of the various insecticides tested 0.2% BHC in the form of Gammexane or Hexidole water suspension spray soon after the plants have put on new growth, gave sufficient protection to the new mango shoots against the pest.

The workers are thankful to Prof. M. S. Mani for the identification of the insects.

Entomological Lab., H. L. KULKARNY.
Inst. of Agriculture, Anand, R. C. PATEL.
August 7, 1952.

STUDIES IN ROOTING RESPONSE

PETIOLES of the detached leaves of the following plants responded to hormone treatment resulting in rooting. *Dolichos lablab* Linn. produced profuse roots in almost all concentrations of β -indolyl butyric acid (5-100 p.p.m.), lower concentrations being preferable. *Canavalia ensiformis* also responded favourably to hormone solutions. In the case of *Ipomœa batatas*, Lamk., aqueous solutions of β -indolyl acetic acid (I. A. A.), β -indolyl butyric acid (I. B. A.) and α -Naphthalene acetic acid (N. A. A.) were tried. Higher concentrations (100 and 50 p.p.m.) of the two hormones I. A. A. and N. A. A., and lower concentrations (10, 5, and 2.5 p.p.m.) of the I. B. A. appear to produce the optimum results. 2.5 p.p.m. of the I. B. A. is the best concentration for rooting.

Dept. of Botany, B. SAMANTARAI.
Ravenshaw College, G. MISRA.
Cuttack-3, T. KABI.
September 22, 1952.

ZYGAENODES SP., A REMARKABLE BEETLE WITH STALKED COMPOUND EYES

A SINGLE adult male beetle belonging to the genus *Zygænodes* Pasc. (Family Anthribidæ: Coleoptera) was collected in November 1951, from Trivandrum. The flying insect was caught and swept down into an open dish on the table by the current of the fan. On examination, the insect proved to be remarkable in the possession of stalked compound eyes (Fig. 1). The eyes are mounted on prominent, short, cylindrical stalks, and the antennæ arise from behind the base of these stalks. The stalks are clothed with very fine, brownish pubescence. The

beetle measures 3.2 mm. in length and 2.1 mm. from eye to eye.

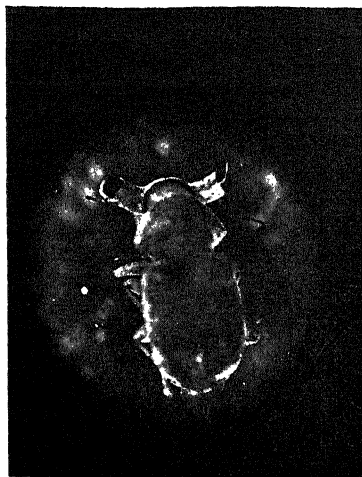


FIG. 1. Photograph of male beetle with stalked compound eyes.

Mr. G. D. Bhasin of the Entomology Department of the Forest Research Institute, Dehra Dun, informs me (*in litt.*) that this beetle does not conform to the description of any known Indian species of *Zygænodes* Pasc., and believes it to be new. The males of this genus have stalked compound eyes, while the females are normal.

It is of interest to note that among insects, only the Dipterous family Diopsidæ have stalked compound eyes. The only other section of insects with stalked compound eyes is the anthribid genus *Zygænodes* Pasc.

Zoology Laboratories, K. K. NAYAR.
University College, Trivandrum,
November 17, 1952.

OCCURRENCE OF THE YELLOW STRAIN OF LAC INSECT *LACCIFER LACCA* KERR. (COCCIDAE) IN DELHI

THE lac insect, *Laccifer lacca*, Kerr., has been observed to occur on pipal tree (*Ficus religiosa*) in Delhi throughout the year. During the month of October 1951, certain swarms of larvæ were seen to consist of two types of individuals: about 40% of them were yellow in colour and the rest red. An examination of the lac encrustation revealed both red and yellow female cells on the same twig. Studies of the morphological characters did not show any difference between the yellow and the red larvæ. This observation is quite significant for there is as

yet no record of the occurrence of this yellow strain in such large numbers.

A palas tree (*Butea frondosa*) was inoculated with the yellow strain in the same month. The individuals on this host were observed to thrive well up to March 1952, but they suffered great mortality during the months of April, May and June probably due to excessive heat and drought. The survivals showed both red and yellow cells in the ratio of 80 to 20. It would appear that the occurrence of a fairly high percentage of yellow strain of the lac insects on pipal tree is related in some way to the quality of nutrients available on this host.

Further observations are being carried out in this Department on the yellow strain of lac insect.

Zoological Laboratory, V. KUMAR GUPTA.
Delhi University, Delhi,
December 10, 1952.

FURTHER EVIDENCE FROM FISH DISTRIBUTION OF THE RISE IN SALINITY OF THE RIVER HOOGHLY

IN 1943, the writer placed on record (*Curr. Sci.*, 12, pp. 89-90) the results of an investigation he carried out for the Corporation of Calcutta in 1938 and showed from the distribution of fishes in the River Hooghly that there was a distinct evidence of a rise in the salinity of the river since 1814. More recently, I¹ had occasion to refer to the infiltration of coarser varieties of *Hilsa* in the lower reaches of the river and now Pillay² has given an account of the fishery of *Hilsa toli* at Falta (about 80 miles from the mouth of the river), Diamond Harbour (about 69 miles from the mouth of the river) and in the Rupnarain River. The significance of this will be clear from the following facts:—

- (1) In Indian waters, *H. toli* is a marine fish and, unlike its congener *H. ilisha* (the famous Hilsa) it is not known to ascend Indian rivers.
- (2) Except for 1951 and 1952 seasons, when *H. toli* was not uncommon in the River Hooghly, it was imported to the Calcutta markets during the previous years from Bombay.
- (3) *H. toli*, unlike the fishes I reported in 1943, is not a demersal species but is a pelagic form and moves in the surface waters.

The inference that can be drawn from the above facts is that the surface waters of the portions of the river, where *H. toli* is now found, have become more brackish during the

last couple of years. Mr. G. S. Madan, Chief Engineer, to the Commissioners for the Port of Calcutta, in a note, based on surface salinity records at Garden Reach and Cossipore, has informed the undersigned that:

- (a) the trends show increasing salinity in recent years; and
- (b) slopes of the trend lines get steeper as the dry season advances at Garden Reach, say, this increase in salinity is more rapid in June than in March.

This increase is relatively less at Cossipore which is further upstream.

Correlated with the relatively less increase in salinity recorded at Cossipore is the fact that Pillay did not find any specimen of *H. toli* at Baghbazar (Calcutta) and at Nawabunge (about 18 miles up the river from Calcutta).

One presumption from the above data is irresistible, and that is this. The bottom wedge of heavier brackish waters may have penetrated deeper into the River Hooghly and it will be interesting, both from the academic and utilitarian aspects, to resurvey the river for its fish fauna during the coming dry season and see how far these fishes can serve as indicators of rise in salinity. It will also be of interest to correlate the fish-survey findings with the investigations now being conducted in regard to training works to improve the channels. It is likely that the rise in salinity has so far effected only the channels below the Port of Calcutta, where the result of the accumulative effect of improved channels may be facilitating the influx of the sea-water. In fact, the fishery of *H. toli* at Diamond Harbour, Falta and in the Rupnarain River is very suggestive of such a process. An intensive biological study of the fauna of the River Hooghly as high up as Nadia and of its tributaries may throw flood of light on the behaviour of the River under training works.

Zoological Survey of India, SUNDER LAL HORA.
Indian Museum, Calcutta-13,
December 19, 1952.

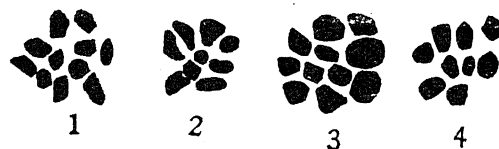
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2. Pillay, T. V. R., *Curr. Sci.*, 1953, 23.

CHROMOSOME NUMBER IN FOUR UMBELLIFERS

In the present note the author records the chromosome number in *Apium graveolens* Linn., *Carum copticum* Benth., *Pimpinella adscendens* Dalz. and *Daucus carota* Linn.

Pimpinella adscendens Dalz., was collected from Khandala in January when it grows gregariously in dry places. The rest of the material was obtained from plants cultivated in college gardens.

Flower buds of various sizes, were fixed in the Navaschin's fluid with a pre-fixation in Carnoy's acetic acid-alcohol-chloroform solution for about ten to fifteen seconds. The usual methods of dehydration and embedding in paraffin were followed. Sections were cut 8μ to 10μ thick and stained in Haidenhein's iron-alum-haematoxylin which gave satisfactory results.



FIGS. 1, 2, 3, and 4 show the first metaphase plate in *Apium graveolens* Linn., *Carum copticum* Benth., *Pimpinella adscendens* Dalz. and *Daucus carota* Linn., respectively, $\times 750$.

The chromosome counts were made in the polar views of the first and second metaphases in the pollen mother-cell nuclei. The haploid numbers and the sizes of chromosomes for different plants are given below:—

| Tribe | Plant | n | Size of the chromosomes |
|----------|------------------------------------|----|------------------------------------------------------------------|
| Aminineæ | <i>Apium graveolens</i> Linn. | 11 | Seven large, two medium, and two small |
| " | <i>Carum copticum</i> Benth. | 9 | One large, four elongated, three of medium sizes, and one small |
| " | <i>Pimpinella adscendens</i> Dalz. | 11 | One largest, three large, six medium and the remaining one small |
| Dauceæ | <i>Daucus carota</i> Linn. | 9 | All same size except one which is small |

The chromosome count for *Apium graveolens* Linn. agrees with that recorded by Wanscher.¹ The diploid number of *Daucus carota* Linn. is 22 according to Melderis¹ while Tamamschjan¹ and Maude² state it to be 18. The present count confirms the observations of the last two authors. The haploid chromosome numbers in the remaining two plants, e.g., *Carum copticum* Benth. and *Pimpinella adscendens* Dalz. have been determined for the first time.

The author is thankful to Dr. R. D. Adatia for the help rendered by him during the investigations.

St. Xavier's College,
Bombay-1, January 21, 1953.

G. L. SHAH.

1. Cited from Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945, George Allen and Unwin Ltd., London. 2. Maude, P. F., *New Phytol.*, 1940, **39**, 17.

TWO-DIMENSIONAL CIRCULAR PAPER CHROMATOGRAPHY

It is well known that in two-dimensional sheet chromatography, the mixture is spotted near one corner of the sheet. During the development with the first solvent in one direction, it is obvious that only a very narrow "ribbon" (somewhat wider than the diameter of the spot) of the entire sheet is involved. After this development, the sheet is dried, and then developed at right angles with a second solvent. Now, of course, the entire sheet of the paper is made use of.

Looking at this aspect of the two-dimensional paper chromatographic technique from the above point of view, a slight modification in it was attempted, which subsequently was applied to obtain a two-dimensional circular paper chromatogram. In doing so, the circular paper chromatographic technique of K. V. Giri and N. A. N. Rao¹ was made use of.

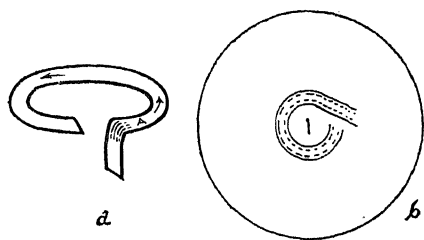


FIG. 1. *a*: The ring, tail end bent downwards. The hydrolysate was spotted at A and the arrow indicates the direction of the flow of the solvent in the ring when developed independently. *b*: This ring later stitched on to the disc. Now the flow of the liquid was from centre outwards.

PROCEDURE

A ring of Whatman filter-paper No. 1 was cut out, keeping a tail, which was subsequently bent downwards to dip into the solvent (Fig. 1*a*). A fish protein HCl-hydrolysate (5 μ gm. of N; pH, 6.5) was carefully spotted at A, fairly above this bend, and the ring was deve-

loped horizontally using butanol: acetic acid: water :: 4:1:5 as solvent.² This ring was 0.5 cm. in width, and its outer diameter was 6 cm. The development was effected in a small glass tank covered with a glass plate.

After the development and air-drying, the ring was stitched on to a 24 cm. disc of Whatman filter-paper No. 1 (Fig. 1*b*), and the disc developed horizontally according to the technique of Giri and Rao (*loc. cit.*), using the same solvent, but freshly prepared, as was used to develop the ring.

The chromatogram was then air-dried, sprayed with a 0.4 per cent. ninhydrin solution made in 75% acetone, and then placed in an oven at 65° C. for 20 minutes (Fig. 2).



FIG. 2. The arrow indicates the direction in which the ring was developed independently.

The bands due to the amino acids (identified by the usual methods) are clearly seen, their outer tips forming a fairly smooth spiral. The faint circle in the middle is evidently due to machine-stitching of the ring, since when hand-stitched this circle does not appear. But in the latter case the development was a bit unsatisfactory.

Multiple run technique used at the two stages improves the result. Work is in progress to find out the effect of change of solvent over a wide range, and also to find out its quantitative possibilities.

The assistance given by Shri R. P. W. Master and Shri J. Barnabas is gratefully acknowledged.

Wilson College, Bombay-7,
January 6, 1953.

J. W. AIRAN.

1. Giri, K. V. and Rao, N. A. N., *Nature*, 1952, **16**, 923; *J. Ind. Inst. Sci.*, 1952, **34**, 95. 2. Partridge, S. M., *Biochem. J.*, 1947, **42**, 238.

REVIEWS

Punched Cards, Their Applications to Science and Industry. Edited by R. S. Casey and J. W. Perry. (Reinhold Publishing Corporation, New York), 1951. Pp. viii + 506. Price \$10.00.

As Vannevar Bush stated in a recent article, "publication (of research) has been extended far beyond our present ability to make real use of the record. The summation of human experience is being expanded at a prodigious rate and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square-rugged ships". Even on a small scale, individual scientific workers are often faced with the problem of tracing the needed entry in their files of information, particularly if they are interested in more than one narrow field. It has been discovered that the use of hand-manipulated punched cards of simple type considerably simplifies such problems.

Then again, there are many problems in the scientific laboratory, such as identification of a substance from its physical properties, or the classification of compounds according to their chemical formula, and in these cases also punched cards come in very useful. For the scientific computer the advantages of using a mechanical aid hardly need to be stressed. A very extensive literature has grown up on the use of punched card calculating machines for various types of computations. The book under review contains a comprehensive survey of all these applications of punched cards, and the editors must be congratulated for getting together in a single volume information on such a wide variety of topics. Part I of the book covering about 80 pages describes the elementary manipulations of hand-sorted punched cards, descriptions of some of the commercially available card systems and a general account of the fundamental procedures involved in applying punched cards to specific problems. Part II is a highly instructive account of various cases in which punched cards have been profitably applied, and forms perhaps the main part of the book. Among these may be mentioned in particular, the use of punched cards in the identification of unknown substances by optical properties, in the preparation of reports, papers and books and in routine library operations. Part III, which is more general and theoretical

in nature, is concerned with fundamental problems. Its scope is best illustrated by the titles of some of the chapters—"Mathematical Analysis of Coding Systems", "Correlation of Research Data and Establishment of Cause and Effect Relationships", "Applications of Punched Card Methods to Scientific Computations". There is an excellent classified bibliography on the use of punched cards, covering 30 pages at the end of the book.

On the whole it is a well edited and well documented volume and the reviewer warmly commends it to all libraries devoted to science and technology.

G. N. RAMACHANDRAN.

X-Ray Crystallographic Technology. By A. Guinier. English Translation by T. L. Toppel. Edited by K. Lonsdale. (Published by Hilger and Watts Ltd., London), 1952. Pp. xiii + 330. Price 56 sh.

This is an English translation of the original book in French by Professor Guinier, which obtained an excellent reception. There is very little change in the new edition except that some of the appendices have been brought up to date, and all data regarding wavelengths and crystal dimensions are given in c.g.s. units (Ångströms).

Although a large number of books have been written about X-ray crystallography during recent years, the book under review is unique and has a special value of its own. It deals with the practical aspects of the field, although many fundamental theoretical conceptions are explained in a brief and succinct manner. Written in the style typical of French scientific books, the author spares no effort to explain things clearly even at the expense of a few extra pages. The translator must be specially complimented for fully preserving the clarity of the original version.

The first two chapters, comprising Part I of the book, deal with the general properties of X-rays and the description of the apparatus for producing X-rays. The second part contains the elements of crystallography and the theory of X-ray diffraction by crystals. The next part on experimental methods is mainly concerned with the procedures for obtaining and indexing powder and rotating crystal photographs. The

fourth and fifth parts are devoted to the applications of X-ray crystallography, such as the study of crystal texture and imperfections, the investigation of amorphous substances and the measurement of the sizes of submicroscopic particles by low angle scattering. The appendices contain a wealth of numerical data such as a table of atomic scattering factors, wavelengths of emission lines and absorption edges, absorption coefficients, tables for converting θ to lattice spacings for various wavelengths, and crystallographic data of the elements and some common compounds.

The book is addressed specially to technicians who want to use the methods of X-ray crystallography and not to crystallographers. Nevertheless, it must find a place on the table of every one interested in X-ray crystallography and its application.

G. N. RAMACHANDRAN.

Substation Practice. Second Edition. By T. H. Carr. (Chapman & Hall Ltd., London), 1952. Pp. 467. Price 55 sh.

The book under review is the second edition of the author's well-known book first published in 1947.

Substations play a very important function in an electrical power system—its importance has been more pronounced with the present-day development of interconnected power systems. The first edition of the book fulfilled a need for authoritative information on the subject of substations design, construction and operation. The need of a second edition in five years shows the wide interest in and the usefulness of the book.

Although no radical changes have been made either in the design and siting of substations or in their equipments since the first edition, there has been added experience in respect of applications of substation equipment. Further, as a result of the electrical supply industry in the United Kingdom having been placed under national ownership, there has been some important developments towards standardization in matters relating to the design and operation of substations.

The new edition includes additional information, illustrations and worked examples in explanation of the points discussed and brings the text up to date with the present-day practices for distribution substations. Minor errors in calculation which appeared in the first edition have now been corrected.

The book deals very effectively with the administrative and engineering problems in connec-

tion with the choice and location of sites for substations, different types of substations and their design and accessories and the commissioning and operation of the main and auxiliary electrical equipment of substations. It will be useful as reference to main and substation engineers as also to consulting engineers, operatives and students.

C. S. GHOSH.

Tables for the Analysis of Beta Spectra. (N.B.S. Applied Mathematics Series 13), 1952. Pp. 61. Price 35 c.

The Fermi theory of beta spectra is now well established, especially in the case of transitions that are termed as "allowed". After obtaining experimental data on beta spectra, one is faced with the task of analysing the data, according to the Fermi theory, which involves the use of the F function of a complex argument. The function cannot be readily evaluated and has not yet been extensively tabulated. This book of tables is intended to supply this need and it is hoped by the authors that it can be effectively utilized for most of the current and of the foreseeable needs of beta-ray analysis. The main tables which extend over 41 pages of this book, give the value of the so-called "Fermi Function", $f(Z, \eta)$, which is required for constructing the Fermi-Curie plots of the beta-ray spectra. The tabulation covers all the values of atomic number, Z , that may be encountered in practice, and extends to $\eta = 7$, where η is the electron momentum in units of mc . The set of values of η is considered sufficient for calculation of the function at intermediate values to be made by interpolation. The tables have been designed for application to the special case of "allowed" spectra.

The earlier portions of the book, extending over 21 pages, give an account of beta-ray theory and a description of how analysis of beta spectra is carried out. Graphs and figures are used to illustrate the distinction between "allowed" and "forbidden" spectra. Auxiliary conversion tables setting out values of quantities used in beta-ray analysis in terms of electron momentum and energy are given. For its size, the book is an admirably exhaustive account of beta-ray analysis and it will no doubt prove to be a valuable mathematical aid to the experimental workers in this field and also to those interested in theoretical aspects of beta-decay.

B. V. THOSAR.

The Basis of Mine Surveying. By M. H. Had-dock. (Published by M/s. Chapman & Hall Ltd., London), 1952. Pp. xii + 301. Price 30 sh. net.

The fundamentals of mathematical problems involved in the field of Mine Surveying is well covered in this book. As the author indicates, no attempt is made to include practical surveying problems, as the main purpose of this work is to give the students in mine surveying, a thorough understanding of the fundamentals of the geometrical and trigonometrical problems involved in mine surveying. The properties of the triangle, polygon and the circle are clearly brought out and compiled in a most useful manner.

The chapter on the subdivision of areas in mining gives interesting and useful methods of aerial subdivision of various geometric figures as are likely to be investigated by the mine surveyor. The subdivision of conic areas in mine surveying has also been dealt with. The problems of resection and countersection which arise often in triangulation are treated in their various aspects. In the section on cross-cutting, methods of space analysis, or plane, or spherical trigonometry are used as much as possible curtailing the applications of calculus only to the computation of extreme values.

Chapter V on Mechanical Methods of Computation give many artifices by means of which a speedy solution is arrived by methods which are especially adapted to the surveyor.

Finally, in the chapter on "Explanatory Heads" the author has emphasised the necessity for 'seeing solid' in three dimensions the various problems arising in the nature of mining survey without which capacity the work of the technician in three dimensional properties is indeed difficult.

The book is not only useful to the mining surveyor but is of general interest to the mathematician as well.

P. MURUGA MANICKAM.

Guide to Blue Print Reading. By Ayachitam Sripada Rao, Organiser, Tech. Design Institute. (Published by the Technical Design Institute, Bangalore).

Blueprint reading presupposes the capacity to get a correct idea of the actual shape and size of the three-dimensional objects which the drawing represents. Many conventions and practices have been adopted in the making of engineering drawings so as to simplify the task of making the drawing, and also to enable proper use to be made of the drawing in the pro-

duction of the article that the drawing represents.

The author in this booklet has dealt with the conventions and practices adopted in engineering drawings, and the proper interpretation of the graphical and other symbols used in the drawing as also the proper notation, numbering, and classification of drawings for easy identification and reference according to recognised methods of drafting room practice. This aspect of the subject is rarely dealt with in the manner as put forth by the author, in a concise and useful form. The book would therefore be very useful to engineers and others engaged in the manufacture and production of machine parts. Though much of the information contained in the tables and data given in the book relates to the aircraft industry, it will still be of much use to the general workshop technician.

P. MURUGA MANICKAM.

Electrochemical Data. By B. E. Conway. (Published by Elsevier; Distributors: Cleaver-Hume Press, London), 1952. Pp. xviii + 374. Price 55 sh.

This book is a unique compilation of physico-chemical data covering a wide region in electrochemistry and allied branches of science and not generally available in handbooks.

The sets of tables given in the ten chapters of the book are each prefaced with a short introduction and are authenticated with complete references. The first chapter contains a collection of universal constants and conversion factors of importance in electrochemistry. In Chapter II are included data relating to those physical properties of solids and solutions that have a bearing on their electrochemistry. Apart from the physical properties of organic solvents, this chapter also contains ionic entropies, interatomic distances and ionic radii, electrical resistivities of metals, polarisabilities of ions and molecules, etc. The next chapter is mostly devoted to activity coefficient and osmotic coefficient data. Conductance data of organic and inorganic salts in various solvents form the subject-matter of the fourth chapter. The next chapter contains mostly the values for the thermodynamic dissociation constants of acids and bases including amino acids and peptides. Data relating to the electrical double layer at interfaces including the electro-kinetic properties of substances of biochemical interest such as mammalian hæmocytes are tabulated in the sixth chapter. The next chapter is devoted to the electrophoretic mobilities of proteins, and the importance of these values in the character-

isation of proteins is clearly indicated. In the eighth chapter there is a collection of data relating to fused electrolytes and solid electrolytic conductors. It is indeed a happy idea to present these data together in a single chapter, rather than disperse the material throughout the book.

Values relating to reversible electrode processes such as reversible potentials, redox potentials, halfwave potentials, etc., form the subject-matter of the ninth chapter. The last chapter contains a selection of the available determinations of the parameters of a number of electrode reactions such as evolution of hydrogen, deuterium, oxygen, etc., at different electrode surfaces.

It is clear that every effort has been made to make the book as up to date as possible by incorporating the results of all recent work. A volume with such an exhaustive and useful collection of data must find a place in all advanced scientific libraries, including industrial libraries. The format of the book maintains the high standard that one associates with Elsevier's publications.

A. P. M. NAIR.

Shock Syndrome—Annals of the New York Academy of Sciences, Vol. 55. Art. 3, 1952. Pp. 345-542.

The contents of this number were first presented at a symposium on the subject held by the Section of Biology of the New York Academy of Sciences towards the end of 1951. They deal with different themes associated with Shock Syndrome either with reference to its pathology or treatment. Supplementary or complementary findings are sought to be fitted in with a view to complete the "puzzle" of shock syndrome.

The conception of shock as arising from the toxic effect of "juices" from within the cell when applied without provokes thought with regard to the nature of the "juice", why and how it is released, its effects—local and general, measures possible to combat or circumvent its adverse results, etc. These ideas have led to valuable findings by the participants in the symposium. The amount of blood loss, the role of coronary circulation changes in capillary bed, kidney functions, role of 'adrenal-pituitary axis', electrolytic pattern, bacterial factor among others are some of the aspects discussed with reference to the pathology and etiology of the Shock Syndrome. The logical sequel is the treatment of the condition, based on the above findings. This aspect is examined under "Physico-Chemical Aspects of Plasma Substitutes"

(given the fashionable nomenclature of "Plasma Extenders") "Dextran and its Value", "Polyvinylpyrrolidone" (Kollidon or Periston or Suboosan or Macrose), "Despeciated Protein" (immune horse serum protein treated), their merits compared to whole blood and blood plasma and the practical utility of each for civilian use, or for armed forces in action.

As each subject is likely to interest workers in similar or allied fields, a comprehensive survey such as the one under review of Shock Syndrome with reference to its pathology and treatment is certain to interest medical men, and the book should most legitimately find a place in the library of any research institution and on the shelf of any clinician who desires to treat 'Shock' with real understanding.

V. ISWARIAH.

Mineral Production of the Indian Union during 1948. (*Records of the Geological Survey of India*), Vol. 82, Part 3, 1952. Pp. 329-529. Price Rs. 2-8-0.

According to the above publication, the total value of minerals produced in the Indian Union during the year 1948 was over Rs. 70 crores and the total value of metals manufactured during the year was of the order of Rs. 40 crores. The publication gives also the figures for 1939 for furnishing an idea of the progress made in the mineral industry during a span of 9 years. In 1939 the total values of the minerals and metals produced were Rs. 21.5 crores and Rs. 18.2 crores respectively. The corresponding figures for 1947, the year immediately preceding the one under review, were Rs. 64 crores and Rs. 21 crores.

The first part deals with the statistics of production and value of minerals and metal products. The notes on each mineral give data regarding its uses, treatment, average annual world production, Indian occurrences, reserves, quality and grade, production in the year under review and also the year preceding, figures of exports and imports, consumption in Indian industries and future prospects. The second part deals with the statistics of mineral concessions granted and terminated during the year 1948.

Proceedings of the Symposium on the Rajputana Desert. (Published by the National Institute of Sciences of India), 1952. Pp. v + 302. Price Rs. 13-2-0.

The Rajputana Desert is an important national problem which requires not only a great deal of knowledge but also careful planning for its

solution. The volume under review is therefore to be welcomed since it contains authoritative articles on various aspects of the problem from experts in the different fields. The list of papers presented at the Symposium relate to : evolution of the desert, geology and mineral resources, topographical survey of the desert region and its possible extension, meteorology and hydrology, animal and plant ecology, soils and agriculture, afforestation, reclamation and control. The recommendations adopted by the Council are given in an Appendix.

The Journal of the Madras Institute of Technology, Vol. I, No. I, 1952. Pp. 152. Price Rs. 4.

The Journal of the Madras Institute of Technology, the first issue of which was issued recently, is mainly devoted to the publication of articles on the technological aspects of science and engineering. The Editor, Dr. A. Narasinga Rao, deserves our warmest congratulations for the varied fare presented in this inaugural number. W. Repenthin has given a thirty-page review of the Aeronautical Science of To-day. Other review articles are by S. V. Ananthakrishnan on the 'Oxidation of Hydrocarbons', R. Wallauschek on the Giorgi (M.K.S.) System of Units, and V. Subramaniam on Patent Law. The journal also includes some original papers—R. Filipowsky has a paper on the Numerical Calculation of Determinants. K. K. Clark's paper presents a general form of solution for the response of a linear network to a sinusoidal or step type functions. Dr. Narasinga Rao's paper on the so-called "Kalidasa Effect" is a mathematical discussion of a statement of Kalidasa that curved lines look straight when seen from a distance. A. Suszkin has described an oscillographic method of measuring very small

time intervals. There is also a historical note on the origin, growth and progress of the Institute.

Books Received

- Botany of Sugarcane*. By C. Van Dillewijn (The Chronica Botanica), 1952. Pp. xxii + 371. Price not given.
- Encyclopedia of Chemical Technology*. By Raymond E. Kirk and Donald Fothmer. (Interscience Publishing Co.) Vol. IX. Pp. xvi + 943. Subscription \$ 25.00. Single Copy \$ 30.00.
- Maharaja Sawai Jaisingh II of Jaipur and His Observatories*. By M. F. Soonwala. (Jaipur Astronomical Society.) Pp. iii + 43. Price Rs. 2.
- Progress in the Chemistry of Fats and Other Lipids*. By R. T. Halman. Vol. I. (Pergamon Press Ltd.). Pp. 186. Price sh. 42.
- Prestressed Concrete*. By Dr. Kurt Billig. (Macmillan & Co. Ltd.). Pp. x + 470. Price 36 sh. net.
- Plant Life in the Scottish Highlands*. By A. E. Holden. (Macmillan & Co. Ltd.) Pp. xiv + 319. Price 30 sh.
- Inorganic Chemistry*. By Joseph Reilly. (Cork University Press, Oxford.) Pp. 71. Price 8 sh. 6 d.
- Symposium on Indian Oils and Fats and Their Utilization*. By Dr. J. S. Agarawal. (Dabholker Press). Pp. 266. Price Re. 1.
- Electrical Units with Special Reference to the M. K. S. System*. By Erric Bradshaw. (Chapman & Hall). Pp. 64. Price 9 sh. 6 d.
- Statistical Methods for Chemical Experimentation*. By W. L. Gore. (Interscience Publishing Co.). Pp. xi + 210. Price \$ 3.50.
- Advances in Geophysics*. By H. E. Landsberg. Vol. I. (Academic Press.) Pp. xi + 362. Price \$ 7.80.

SCIENCE NOTES AND NEWS

Orobanche on Wheat (N.P. 52)

Shri S. L. Sharma, Central Sugarcane Research Station, Pusa, Bihar, writes as follows :—

This root-parasite has been known, long time back, to attack several plants belonging to Solanaceæ, a few of Crucifereæ and a plant or two of about half a dozen natural orders including Gramineæ of which *Cynodon dactylon* was recorded to have been parasitised by *Orobanche indica* Ham. (= *O. ægyptica*. Pers.) (Shaw, F. J. F., *Mem. Dep. Agri. India Bot. Ser.*, 1917,

9, 107-31). But so far there does not appear to be a record of any of its species occurring on wheat. (Kumar, L. S. S., "Flowering plants which attack economic crops—II. *Orobanche*", *Ind. Farm.*, 1942, 3, 638-40). *O. cernua* Lœffl. (Duthie, J. F., *Flora of Upper Gangetic Plain*, 1911, 2), was found to attack wheat plants (N.P. 52) which were growing along with *Brassica campestris* var. *Sarson* in February 1951. As crop was mixed, at first it appeared as if the root-parasite was growing

on its usual host. But there were about half a dozen isolated wheat plants which had *Orobanch*e in close vicinity and too far away from *Sarson* plants. When their root-systems were washed, definite organic contact between the roots of wheat and *Orobanch*e as distinct from mechanical intermingling, was found to exist.

Grateful thanks of the author are due to Shri K. L. Khanna for his keen interest in this investigation.

Breeding of Mirror Carp, *Cyprinus carpio*, in Coorg State

Shri S. H. Husainy, Department of Fisheries, Coorg, writes as follows:

In pursuance of a programme for development of fisheries in Coorg State, a consignment of 50 fingerlings of Mirror carp was imported from Ooty in 1948 and stocked in a perennial tank in Somwarpet. The first trial netting was conducted on 7-10-1952 with a small meshed cast net and 153 young ones (1½ to 3 inches in size) and a few adults (above 15 inches in size) of Mirror carp were obtained, thus indicating that this exotic fish has bred in this water and that it can be used for expansion of fish cultural operations in the State. It is also significant that this is the first instance of Mirror carp breeding at an elevation lower than 4,500' in India. (cf. Alikunhi, K. N. and Ranganathan, V., *Curr. Sci.*, 1946, 15, 233; Chacko, P. I., *Progress Report on the Madras Rural Piscicultural Scheme*, 1949-50; *Ibid.*, 1950-51).

Symposium on Spectroscopy

The American Association of Spectrographers is planning a symposium on "Emission Spectroscopic Determination of Metals in Non-Metallic Samples". The symposium will be held in Chicago on May 1, 1953. Contributed papers in the fields of petroleum, geology, agriculture, pharmacy, biology, ceramics, etc., are welcome. All inquiries may be addressed to: J. P. Pagliasotti, Chairman, Symposium Committee, c/o Standard Oil Company (Indiana), Box 431, Whiting, Indiana, U.S.A.

National Register of Scientific Personnel

Part I, Volume 3 of the *National Register of Scientific and Technical Personnel in India* has just been published by the Council of Scientific and Industrial Research.

The publication lists scientists and technologists under different categories of the profession such as mathematics and statistics, physics, meteorology, chemistry, geology and mineralogy, metallurgy, anthropology, botany, zoology and entomology, agriculture and horticulture, plant breeding and genetics, plant pathology, animal

husbandry and dairying, veterinary science and forestry. Experience of research, teaching, scientific and technical administration, etc., has been indicated against each person appearing in the list.

The *National Register*, which will be periodically revised and brought up to date, will provide a continuous census of the scientific manpower of the nation.

Handbook of Fish Culture Practices

At the invitation of the Food and Agricultural Organisation of the United Nations, Dr. S. L. Hora, Director, Zoological Survey of India, a well-known international authority on fish culture, has undertaken the preparation of a Handbook of Fish Cultural Practices in the tropical and sub-tropical countries of the world. The Handbook, which is expected to be ready by the end of next year, is intended to serve as a practical guide to fish culturists and fisheries extension workers in the underdeveloped countries of the world, where immense possibilities exist for the improvement of the diet of the people through the development of fish culture. Any person having information on fish cultural practices is requested to send it to Dr. Hora at Museum House, 1, Sudder Street, Calcutta-13, so as to make the Handbook as complete as possible.

Bangalore Machine Tool Factory

The Bangalore Machine Tool Factory which has been recently incorporated by an agreement of the Government of India with the Oerlikon Machine Tool Works, Zurich (Switzerland), is expected to go into production towards the end of the year.

The authorised capital of the Company is Rs. 12 crores and its production programme covers the manufacture of high-speed lathes, heavy duty drilling machines, shaping machines, milling machines, etc. Considerable progress has been made in the construction of the factory buildings at Jalahalli near Bangalore and also in regard to the procurement and installation of capital equipment.

Coelacanthid Fish

On December 22, 1938, a fish of *Crossopterygian* type was taken by trawl-net, at a depth of about 40 fathoms some miles west of East London. The animal was unquestionably alive when caught. It was 1.5 metres in total length and weighed 127 lb. The colour was a bright metallic blue which faded to brown with preservation. This discovery naturally aroused great interest, although much disintegration of

parts had occurred. Until then, only fossil records of coelacanthid fishes, believed to have been extinct for about 50 million years, had been available. Further details of this fish were published in *Nature* (143, 748; 1939) by Prof. Smith.

Now comes a report of further catch. This second fish was reported as having been caught on December 20, 1952, off the island of Anjouan in the Comoro group, 200 miles west of Madagascar. It was reported to be about 5 ft. long and to weigh about 100 lb. Preliminary reports suggest that the state of preservation of the fish is satisfactory. It is of interest to note that the fish was caught in 20 m. of water by an Arab, using a line, and that the islanders claim that 2 or 3 such fish are caught each year in the same region and sold in the local market. Further details are awaited with considerable interest.

Artificial Rain Precipitation

Microwave radar has proved easily the most valuable research tool for this field of study. When used from the seeding aircraft, clouds can be "probed" by radar to verify whether conditions exist for incipient precipitation. It has been shown that there are many clouds in which all conditions necessary for the formation of rain are present, except one; so that by supplying the missing factor there is a high probability that the precipitation can be "triggered" off.

Tata Gold Medal for Zoological Research

The Sir Dorab Tata Gold Medal of the Zoological Society of India was awarded to Dr. S. L. Hora, Director, Zoological Survey of India, for the best research in Zoology during 1949-51.

Banaras Hindu University

On the recommendation of a Board of Examiners consisting of Prof. Walter Stiles, Prof. E. J. Maskell, Prof. P. Parija and Dr. K. N. Lal, the Degree of Doctor of Philosophy of the Banaras Hindu University has been conferred on Mr. Rajat De, for his thesis entitled "Studies in Nitrogen Nutrition of Sugarcane".

National Institute of Sciences of India

At the Eighteenth Anniversary General Meeting of the National Institute of Sciences of India held at the Central Drug Research Institute, Lucknow, the following were declared Officers of its Council for 1953.—*President*: Dr. K. S. Krishnan (Delhi); *Vice-Presidents*: Prof. K. N. Bahl (Patna), and Prof. S. K. Banerji (Calcutta). *Treasurer*: Prof. D. S. Kothari (Delhi); *Foreign Secretary*: Prof. P. C. Mahalanobis (Calcutta); *Secretaries*: Prof. R. C. Majumdar (Delhi), and Dr. B. P. Pal (Delhi); *Editor of Publications*: Prof. J. M. Sen (Calcutta).

The following were elected Ordinary and Honorary Fellows of the Institute:

Ordinary Fellows.—Mr. K. F. Antia, Bombay, Dr. E. C. Büchi, Calcutta; Prof. H. L. Chhibber, Banaras; Dr. M. V. Govindaswamy, Bangalore; Prof. R. P. Mitra, Delhi; Mr. K. C. Mukherjee, Calcutta; Prof. S. R. Palit, Calcutta; Mr. M. B. Raizada, Dehra Dun; Dr. Atma Ram, Calcutta; Prof. B. S. Madhava Rao, Bangalore; Prof. H. Santapu, Bombay; Prof. B. R. Seshachar, Bangalore; Prof. M. S. Thacker, Bangalore; Dr. W. M. Vaidya, New Delhi.

Honorary Fellows.—Prof. Reginald A. Daly, Geological Museum, Cambridge, Mass., U.S.A.; Prof. J. B. S. Haldane, Professor of Biometry, University College, London; Prof. Hermann Weyl, Institute for Advanced Studies, Princeton, U.S.A.

Zoological Society of India

Officers for 1953: *President*: Dr. M. A. Moghe (Poona); *Vice-Presidents*: Dr. K. N. Bahl (Patna) and Dr. M. L. Roonwal (Dehra Dun); *Treasurer*: Dr. B. S. Chauhan (Calcutta); *Editor*: Dr. N. K. Panikkar (Mandapam); *Manager of Publications*: Dr. M. L. Bhatia (Delhi); *Secretary*: Dr. P. D. Gupta (Lucknow); and *Members*: Dr. S. L. Hora (Calcutta); Dr. H. S. Pruthi (Delhi), Dr. Vishwa Nath (Hoshiarpur), Dr. H. S. Rao (Barrackpur-Calcutta), Dr. D. V. Bal (Bombay), and Shri M. N. Datta (Calcutta).

NOTICE

All material intended for publication in *Current Science*, corrected proofs, books for review and exchange journals, may please be sent to the Editor:

Professor G. N. Ramachandran,
A. C. College of Technology,
Madras-25.

Remittances, correspondence regarding subscriptions to the journal, advertisements and requests for missing numbers, etc., may please be addressed to:

The Manager,
Current Science Association,
Malleswaram P.O., Bangalore-3.



Current Science



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THE RAMAN EFFECT : 1928-53

THE discovery that radiations of altered frequency appear in the light scattered by material media of diverse chemical nature and in diverse physical states was made by Sir C. V. Raman at Calcutta on the 28th of February 1928. The theoretical significance of the observation and its extraordinary importance for the study of molecular spectra in the different states of aggregation, including especially crystals and amorphous solids, were immediately appreciated by him. They are very clearly set out in his lecture on "A New Radiation" which was delivered at Bangalore on the 16th of March and published from Calcutta on the 31st of March 1928. The lecture also described the characteristic features of the effect, viz., the polarisation of the scattered radiations appearing as spectral shifts, the sharpness of the latter in some cases and their diffuseness in others. The concluding paragraph of the lecture contains the following forecast of the developments expected from the discovery. "We are obviously only at the fringe of a fascinating new region of experimental research which promises to

throw light on diverse problems relating to radiation and wave theory, X-ray optics, atomic and molecular spectra, fluorescence and scattering, thermodynamics and chemistry. It all remains to be worked out."

It was not long before the predictions thus confidently made found fulfilment.

HISTORY OF THE DISCOVERY

Chance observations have sometimes led to great discoveries. But in the emergence of the Raman effect, neither chance nor accidental circumstances played any part. Indeed, the faintness of the phenomenon would alone have sufficed to preclude any accidental discovery of it. In the lecture quoted above and again in his Nobel Lecture delivered at Stockholm on the 11th December 1930, Sir C. V. Raman described in detail how he was led to undertake a spectroscopic examination of the light scattered in transparent media, and how when observations with sunlight roughly monochromatised by suitable colour filter indicated the need for truly monochromatic light, he switched over to the use of the mercury arc

lamp. From the publications cited, it is clear that while Raman's collaborators had assisted him in some of the earlier non-spectroscopic studies made with sunlight, he worked alone in the crucial experiments made with the mercury arc lamp and spectroscopic aid which resulted in the discovery of the effect.

In the recently published review of the Nobel awards made during the last fifty years, Professor Siegbahn quite appropriately describes the Raman effect under the chapter heading of "X-Rays in Atomic Research". The investigations of Raman and his school during the years from 1921 to 1928 were largely inspired and directed by the analogies which exist in the optical behaviour of light and of X-rays despite the enormous difference in wavelengths. It is not surprising, therefore, that when Compton published his discovery of the change of wavelength in X-ray scattering, Raman was greatly interested in it. Towards the end of the year 1927, he worked out an explanation of the Compton effect based on the classical ideas of Maxwell's electromagnetic theory of light. A theoretical paper under the title "A Classical Derivation of the Compton Effect" was completed in December 1927, though it was actually published only some months later. In this paper, it was shown that the appearance of two types of X-ray scattering, *viz.*, a modified and an unmodified scattering, as well as their relative intensities and the angular distribution of these two types of scattering around the atom could be deduced in a straightforward manner on the basis of the classical wave principles. It also emerged from the mathematical analysis that the modified scattering of X-rays, unlike the unmodified scattering, is a dynamic effect, arising from the movements of the electrons surrounding the nucleus, and is also fluctuating in its character. These results suggested to Raman that analogous phenomena involving a change of frequency and arising from dynamic fluctuations in molecular structure might also be observable in the scattering of light in transparent media. The next further step was his intuitive recognition that an effect which had been discovered several years earlier in his laboratory and then mistaken for a feeble type of fluorescence was the optical analogue of the Compton effect. It was to test this idea and obtain an experimental proof of it that Raman proceeded to make the observations which resulted in his discovery of the effect.

ORIGIN OF THE PHENOMENON

The explanation of the effect given by Raman in his first publication was that the change of

frequency was the result of an exchange of energy between the light-quantum and the molecule. This was confirmed by exact measurements on the photographed spectra which showed that the alterations in frequency of the scattered light actually observed could be identified with the molecular frequencies of absorption or emission lying in the infra-red region of the spectrum. Spectroscopists everywhere accepted the explanation and it became, in fact, the basis for the interpretation of the immense mass of data that began to pour in when studies of the effect were taken up in numerous laboratories all over the world. Mathematical theorists did not object to the proposed interpretation of the observed effect and were, in fact, pleased when the discovery was announced, as they saw in it a welcome confirmation of the ideas underlying the contemporaneous developments in the quantum theory of radiation pioneered by Smekal (1923), as also by Kramers and Heisenberg (1925).

It seems appropriate here to comment upon the statement often made that the Raman effect had been theoretically predicted some years prior to its experimental discovery. Such a statement overlooks the fact that the type of secondary radiation whose true nature was established by Raman in 1928 had actually been observed at his Institute and recorded in published papers dating back to the year 1923. Then, again, in the years following Smekal's suggestion of 1923 of the possibility of a scattering of light with change of frequency, spectroscopists the world over had searched for the phenomenon but in vain, evidently because the prediction was of too general a nature to be a useful guide. The actual discovery of Raman made in 1928 was, on the other hand, the result of a completely independent approach. Even in the case of the Compton effect, the principles of the conservation of energy and momentum applied to the encounter between an electron and a proton fail to indicate essential features of what is actually observed, *viz.*, the appearance of both a modified and an unmodified scattering, as well as the dependence of their relative intensities on the atomic number of the element and on the direction of the scattering. When we consider the case of the diffusion of light by a complex system, such as a molecule, the idea of an exchange of energy between the light-quantum and a molecule may be useful in explaining what is observed. But it cannot serve even qualitatively to indicate what one may actually expect to observe, since the pos-

sibilities are so numerous. A purely classical approach to the problem of the scattering of light by a vibrating or a rotating molecule is more useful in this respect, though it may be misleading in a quantitative sense. Indeed, it should be said that no theorist had, until after Raman's discovery, considered or dealt with the actual problem involved, viz., the result of the collision between a light-quantum and a molecule or a crystal and forecast the results actually observed.

THE SUBSEQUENT DEVELOPMENTS

The paper containing the original account of the discovery as well as Raman's Nobel Lecture are being re-published in the March issue of the *Proceedings of the Indian Academy of Sciences*. Simultaneously is being published also a general survey of the results of twenty-five years of research on the Raman effect written by Dr. S. Bhagavantam who has been a leader in this field of research in the Indian sub-continent. In view of these forthcoming publications, it does not appear to be necessary here to traverse the same ground. We shall content ourself with quoting the words of Sir C. V. Raman himself spoken on the 25th anniversary of his discovery when he was approached by the Press Trust of India for a message appropriate to the occasion.

"The earlier years following the publication of the discovery witnessed intense activity in the field in many countries and naturally also in India. A new branch of spectroscopy arose with its own distinctive types of instrument, light sources and techniques. A vast body of literature came into existence. The knowledge gathered in the course of years has been systematised and incorporated in several substantial treatises which have been published in different languages. Many shorter memoirs and some thousands of published papers contain more detailed information regarding particular substances or particular topics.

"It may well be asked what all this activity has really led to. The question can be answered without difficulty. Each line in the spectrum of the scattered light with its own characteristic frequency shift is a consequence of a particular mode of vibration of the molecules scattering the light. The entire pattern of lines constitutes the characteristic vibration spectrum of the molecule. This in its turn is determined by the structure of the molecule, in other words, by the number and masses of the atoms composing it, their geometric positions, as well as by the nature and strength of the chemical forces

binding them together. The study of the scattering of light thus furnishes us with information which besides being descriptive of the molecule is also related to its ultimate constitution.

"It follows from what has been said above that the study of the spectrum of the light scattering is a powerful tool in the hands of the chemist who is interested to know what the molecules he is dealing with are and their configurations and properties. Valuable information regarding the symmetry of molecular form and structure and as regards the presence of special types of chemical bond is readily forthcoming by the use of the method. This has helped to resolve some outstanding problems in theoretical chemistry. Changes in the structure of the chemical molecule brought about in different ways, as for instance, by solution, by heating or by reaction with other molecules can be followed. Indeed, the study of light scattering finds application in all branches of chemistry, both theoretical and practical. Of recent years, there has been an increasing recognition also of its value as a tool in analytical chemistry.

"Investigations with gases, especially those having simple molecules, such as hydrogen, nitrogen and oxygen of which the rotation reveals itself in light scattering have been productive of results of fundamental interest from the standpoint of pure physics. Much detailed knowledge regarding molecular behaviour is also forthcoming from the studies of the scattering of light in liquids. Indeed, some startling discoveries have resulted, as for instance, the proof that highly viscous liquids exhibit a measurable rigidity, thus behaving in some respects like solids. In the field of crystal physics, the study of light scattering has led to advances of a fundamental character. The nature of the vibration spectra of crystals as revealed by light scattering exhibits a remarkable simplicity, which is in striking contrast with the complex and indefinite pictures of it resulting from the assumption that the internal vibrations of the atoms in a crystal are similar in their general nature to the familiar vibrations of an elastic solid. Recent investigations at Bangalore have clarified the situation completely. They have shown that the atomic vibrations in a crystal follow a pattern which is determined by its structure and is wholly unrelated to its size or external boundary conditions. These new findings promise profoundly to influence the future development of crystal physics."

SILVER JUBILEE CELEBRATIONS OF THE RAMAN EFFECT

THE SILVER JUBILEE of the discovery of the Raman Effect was celebrated with great enthusiasm in many places in India. Learned societies as well as public men took the opportunity to express their deep sense of appreciation of the contributions made by the distinguished scientist for the cause of science in India.

At a function organised by the Institute of Science on 28th February 1953 at the Cowasjee Jehangir Hall at Bombay, Prof. Mata Prasad observed that it was the fundamental character of the Raman effect that made it a subject of widespread interest throughout the world. Speaking next, Dr. K. R. Ramanathan gave a graphic description of the events leading to the discovery, and was followed by Dr. H. J. Bhabha who dealt with the nature of the Raman effect. An exhibition was arranged on the occasion by Dr. S. Venkateswaran and the staff and students of the Institute, consisting of enlarged pictures showing the Raman effect in gases, liquids, and solids, several reprints of papers on the subject published in various languages and countries, photographs of some Indian workers on the Raman effect, various apparatus used for its study and so on.

At Madras, the celebration was organised by the Physical Sciences Association in the Presidency College on 28th February when Mr. T. N. Seshadri, President of the Association, presided. Mr. Seshadri referred to the appropriateness of holding the function in the Presidency College, where Sir C. V. Raman had studied and carried out some of his earliest investigations. He added that the discovery had opened out wide fields of research in almost all branches of science. That a discovery of such fundamental importance and such deep significance had come from an Indian this time must be a matter of pride to everyone of us in this country.

Dr. M. A. Govinda Rao, speaking next, said that although the discovery was made in the realm of physics in the course of an intensive study of the scattering of light by liquids and gases, it had a profound influence on chemistry and the development of chemical thought.

Prof. G. N. Ramachandran pointed out that the Raman effect was in the nature of a confir-

mation of the quantum theory of radiation. He observed that the Raman effect was also one of the most conclusive pieces of evidence that led to the idea that the atomic nucleus consisted of protons and neutrons—an idea which led to all the later developments now associated with the name “atomic energy”.

Prof. S. V. Anantakrishnan, dealing with the repercussions of Raman effect on Chemistry said that in several instances the structure of compounds which had been established by the intuitive approach of the chemist had found excellent confirmation from the Raman effect while there had been several instances where the clue had come first from the Raman effect.

Professor K. N. Menon said that the organic chemist was very greatly indebted to the physicist for giving him many methods that helped him in the investigation of the molecular architecture of organic compounds. Probably, the most outstanding example of the application of the Raman spectra was its use by Ingold and his collaborators in the study of the structure of benzene.

On March 16th, the well-known daily, “*The Hindu*”, brought out a special supplement containing messages and articles from scientists both in India and abroad to mark the Silver Jubilee. In his message, Prof. Albert Einstein remarked :

“The progress of empirical knowledge and of the basic ideas about the structure of matter and about elementary phenomena is, indeed, an international process, in which all nations take part. Thus C. V. Raman was the first to recognize and demonstrate that the energy of a photon can undergo a partial transformation within matter. I still recall vividly the deep impression that this discovery made on all of us who at the time attended the Physics Colloquium in Berlin.”

Information has also been received of meetings held at various other places such as the Fergusson College, Poona (28th February), Indian Association for the Cultivation of Science, Calcutta (7th March), and Andhra University, Waltair (16th March). Celebrations were also held by the Association of Scientific Workers at Hyderabad and the South Indian Science Association at Bangalore.

RAMAN EFFECT AND ITS CHEMICAL APPLICATIONS
Twenty-five Years in Retrospect

S. V. ANANTAKRISHNAN

Dept. of Chemistry, Madras Christian College, Tambaram, S. India

ON 16th March 1928, Prof. C. V. Raman announced in an address in Bangalore the discovery of a new radiation in scattering which has since been termed 'The Raman Effect'.³⁹ At the conclusion of his address we find the prophetic conclusion, "We are obviously only at the fringe of a fascinating new region of experimental research which promises to throw light on diverse problems relating to radiation and wave theory, X-ray optics, atomic and molecular spectra, fluorescence and scattering, thermodynamics and chemistry. It all remains to be worked out". This has been well substantiated

provided us with a large collection of compounds, of which the relative positions of atoms and groups of atoms have been clearly indicated. These have helped in the applications of Raman Effect, while at the same time, the scattering studies have confirmed in a large measure the assignments of structure by the chemist. In this short survey in retrospect, it is not possible to cover the ground of the several thousand papers that have been published, nor is it necessary. There have been numerous monographs on the subject, "each with its distinctive features, but the very nature of the subject makes these serve only as a starting point for further study. We may broadly divide the subject into four divisions: 'Organic Structures'; 'Inorganic Structures'; 'Analytical Applications'; and 'Reaction Mechanisms'.

§ 1. ORGANIC STRUCTURES

Except in the simplest of compounds, the assignment of characteristic frequencies to individual bonds is by no means easy. However, the problem has been simplified, because of the ready availability of a large number of closely related compounds in which changes are confined to parts of the molecule, while one part remains constant. Assignments are then made by essentially empirical rules: that the radicals in question retain their identity and their characteristic frequencies remain constant over a series, without being modified to any appreciable extent by the rest of the molecule. This is probably true of the vibrations of hydrogen along with the valency bond, but, as will be seen later, even this is subject to limitations. In quite a number of instances, the assignments have been made possible by an application of the Teller-Redlich theorem.^{30,41,43} Another method, frequently used with success by Daure,¹² Cabannes,⁷ Kohlrausch²⁵ and others, makes use of changes in frequency caused by a progressive increase in the mass of certain atoms while the rest of the molecule remains unchanged. Using these methods bond-stretching frequencies have been assigned to various bonds, some of which are presented in Tables I, II, III and IV.

It will be noticed from Table I that X-H vibrations show systematic variations with the position of the element X in the periodic table. There is the unmistakable drift in the direction of higher frequencies with increasing differences

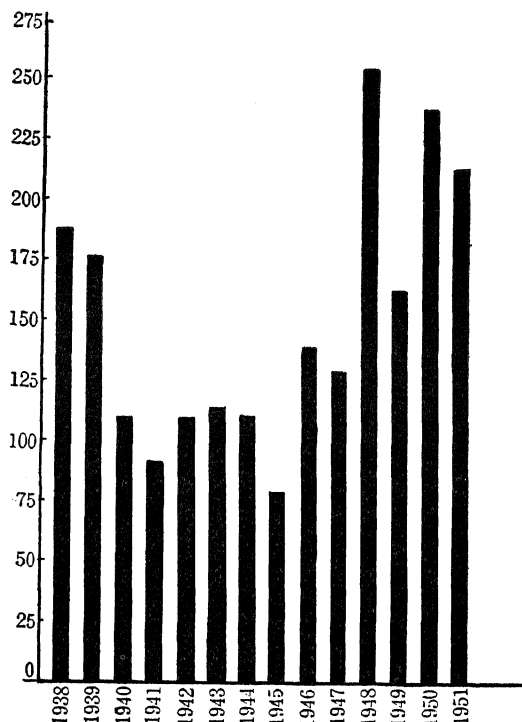


FIG. 1. In the Raman Jubilee Volume of the *Proceedings of the Indian Academy of Sciences* Hibben has analysed the trends in Raman Effect studies upto 1938. The above graph prepared from an analysis of the papers abstracted by *Chemical Abstracts* will be of interest in continuing part of Hibben's analysis. I have to thank Messrs. D. Setu Rao and S. Natarajan for the graph. by the enormous amount of work on the phenomenon published during the last twenty-five years. The classical organic chemist by a combination of intuitive and empirical approach has

TABLE I
(a) Characteristic frequencies of X-H bonds

| Element | .. | B | C | N | O | F | Si | P | S | Cl |
|----------------|----|-------|-----------|-----------|-----------|--------|---------|------|------|------|
| Raman Line | .. | 2590 | 2960-3300 | 3300-3380 | 3400-3680 | (4140) | 2160-90 | 2400 | 2680 | 2800 |
| Force Constant | .. | (3.6) | 4.97 | 6.49 | 8.35 | 9.62 | | 3.10 | 4.02 | 5.13 |

(b) Characteristic frequencies of X-X bonds

| Element | .. | C | N | O | Si | P | S |
|-----------------------|----|------|------|--------|-----|-----|-----|
| Single bond Frequency | .. | 900 | 880 | 877 | 435 | 465 | 467 |
| Double bond Frequency | .. | 1640 | 1442 | (1280) | | | |
| Triple bond Frequency | .. | 2050 | 2328 | | | | |

TABLE II
(a) Variations in C-H frequencies

| Compound | Frequency | Compound | Frequency | Compound | Frequency |
|--------------------|---------------------|----------------|-----------|------------------|-----------|
| Methane | .. 2918 | Ethylene | 3019 | HCN | 3312 |
| Ethane | .. 2913, 2943 | Propylene | 3012 | Acetylene | 3287 |
| <i>Iso</i> -Butane | .. 2910, 2936, 2962 | Vinyl Chloride | 3036 | Methyl Acetylene | 3305 |
| Nitromethane | .. 2967, 3056 | | | | |

(b) Change in frequencies of C-C bond

| | | | | | |
|--------------------|-------------------|-----------------------------|------|--------------------|-----------|
| Ethane | .. 990 | <i>Iso</i> -Propyl Chloride | 1059 | Ethyl Chloride | 1120, 950 |
| Propane | .. 870, 1050 | .. Bromide | 1038 | <i>n</i> -Butyl .. | 1153 |
| <i>n</i> -Butane | .. 979 | .. Iodide | 1019 | .. Bromide | 1142 |
| <i>Iso</i> -Butane | .. 794, 964, 1098 | .. Mercaptan | 1056 | .. Iodide | 1131 |

in the electronegativities of the element with reference to hydrogen. Pauling³⁵ has shown that these differences can be correlated with the degree of ionic character of the bond in question. One can then expect that the hydrogen-fluorine bond is essentially ionic and this is confirmed by the non-observance of a Raman Line even in the most concentrated aqueous solutions of hydrogen fluoride. The changes observed are similar, both for the first and the second short periods but, as may be expected, the values are consistently lower in the latter case. The period relationship is found also when we consider the X-X bond. The individuality of the molecule is clearly demonstrated by the variations noticed in both C-H and C-C bonds and similarly variations in group interactions are exemplified by ethylenic and carbonyl frequencies.

In most correlations of physical properties with structure, it is generally assumed that the contribution of the methylene group or the C-H and C-C bonds remains constant. Careful analysis has, however, revealed that this assumption is not justified (cf. Walsh⁴⁴). Since bond

dissociation energies are related to the characteristic frequencies, a similar position may be expected here also. Table II illustrates the extent of variation involved. Bartholomé and Teller have shown that C-C single bond vibrations lie in the region 809-1143 cm.⁻¹,⁴ but because of overlapping C-H bending vibrations caused by intramolecular forces, assignment may be difficult. Kellner has indicated a theoretical method for the purpose of assigning C-C frequencies.²³

The importance of group interactions within the same molecule are even more noticeable in the case of ethylene derivatives and the carbonyl compounds (Tables III and IV).

Isomerism of different types in the case of carbon compounds has been built up and illustrated by several compounds using two simple principles: (i) the valency of carbon is constant having a value of four and with the bonds directed towards the four corners of a tetrahedron, carbon being at the centre; and (ii) free rotation is possible round a single bond but multiple bonds cause greater rigidity. Recent developments in valence theories have

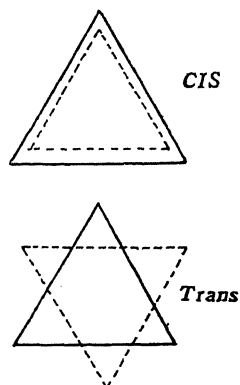
TABLE III
Characteristic frequencies of ethylene derivatives changes in C=C frequencies

| CH ₂ CHX X | Frequency | CH ₂ CX ₂ | Frequency | CHX CX ₂ | Frequency | CX ₂ CX ₂ | Frequency |
|-------------------------------|-----------|---------------------------------|-----------|---------------------|-----------|---------------------------------|-----------|
| H | 1623 | | | | | | |
| Me | 1647 | | 1650 | | 1679 | | |
| D | | | 1581 | | | | 1514 |
| Cl | 1608 | | | | | | 1571 |
| Br | 1598 | | | | | | |
| CHO | 1618 | Allene | 1480 | | | | |
| CH CH ₂ | 1634 | <i>cis</i> Butane | 1669 | | | | |
| CH ₂ Cl | 1640 | <i>trans</i> " | 1681 | | | | |
| C ₆ H ₅ | 1601 | | | | | | |

TABLE IV
Carbonyl frequencies

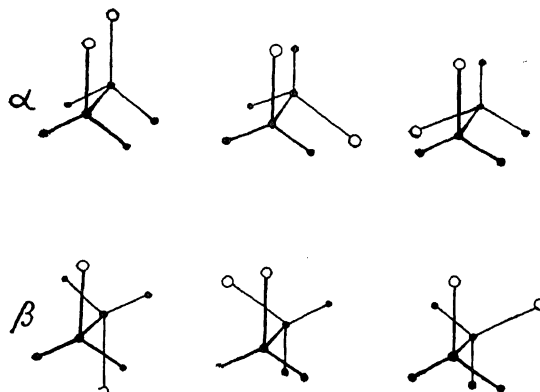
| Compound | Frequency | Compound | Frequency | Compound | Frequency |
|--------------|-----------|-----------------|-----------|--------------|-----------|
| Acetone | .. 1710 | Acetophenone | .. 1677 | Benzophenone | .. 1663 |
| Formaldehyde | .. 1768 | Benzaldehyde | .. 1689 | Fluorenone | .. 1718 |
| Acetaldehyde | .. 1715 | Acetyl chloride | .. 1798 | Oxalic acid | .. 1750 |
| Acetic acid | .. 1666 | Benzoic acid | .. 1647 | | |

not materially altered the situation.¹¹ The thermodynamic properties of ethane and some of its derivatives clearly showed that there is a potential barrier to free rotation and that the methyl groups or substituted methyl groups take up favoured positions. In the case of ethane itself, Raman spectra do not enable one to distinguish between the two alternative forms (Fig. 2)

FIG. 2. Alternative (*cis* and *trans*) forms of ethane.

but hexadeutero ethane appears to have the transform with D_{3d} symmetry.^{16,22,42} The case of substituted ethanes is even more interest-

ing. Taking a number of compounds of the formula CH₂X-CH₂Y Langseth and Bernstein²⁸ have shown other possible configurations also (Fig. 3).

FIG. 3. Possible configurations of the type CH₂X-CH₂Y
Raman spectra studies have thus enabled the detection of the presence of such rotation isomers which are chemically not separate entities if one considers the reactivities alone.

Tautomeric systems have provided us examples of the pitfalls in the use of Raman Spectra data. Kohlrausch,²⁴ from his study of acetyl acetone concludes that it is necessary to consider the presence of two monoenolic and two

dienolic forms, while Lecomte from his infra-red studies on metal acetylacetonates²⁹ concludes that there is no hydroxyl group but makes hydrogen part of a six-membered ring system. This is analogous to the approach of the classical chemist to the question of hydrogen bond. One has to expect variations in both hydroxyl and carbonyl frequencies because of group interactions and, in the case of intermolecular hydrogen bonding, it is also necessary to consider the environment which modifies bond polarisabilities. The valuable extensive work of Murli and Seshadri,³⁴ while providing clear evidence for hydrogen bonding in the systems studied, suffers from this limitation. It is now fairly clear that the hydrogen bond is electrostatic in nature involving an energy change of a higher order than van der Waals forces. While this may cause a preferential orientation of the hydroxyl group, where intramolecular hydrogen bonding is the case, with intermolecular hydrogen bonds, it is difficult to expect the rigidity which is implicit in the structures postulated by these authors.

One of the structural problems that Raman Spectra has helped to solve is that of tetranitromethane. From its reactions, chemists have often favoured the view that one of the nitro groups must be different from the other three. The elucidation of the problem has been the extensive work of Chèdin,⁹ and of Mathieu and his associates.³¹ The analysis of the Raman lines of nitromethane showed that the two parts of the molecule are not free to rotate with respect to each other about the C-N axis. In the case of tetranitromethane this school of workers have shown that each C-NO₂ group lies in one plane. The complete Raman Spectrum requires a tetrahedral symmetry with all the nitro groups equivalent. The difference in reactivity is obviously similar to the differences in energy required for the rupture of a C-H bond in methane where all the hydrogen atoms are equivalent.

An outstanding triumph of Raman Effect studies concerns the elucidation of the structure of benzene. While the early work of Kohlrausch suggested the two equivalent Kekulé structures, the position was uncertain till the classical investigations of Ino'd and co-workers on benzene and its partially deuterated derivatives were made.²⁰ These observations have clearly established the D_{6h} symmetry of the molecule.

In dealing with problems of structure, mention should also be made to the contributions to our knowledge of hyperconjugation involving methyl groups. Comparisons of Raman

Spectra have also shown that with alkyl derivatives, primary compounds show a mobile structure while secondary compounds show a greater degree of rigidity which is still greater in the tertiary compounds. The indications may be noticed even in the C-C single bond vibrations indicated by Kellner (*loc. cit.*).

§ 2. INORGANIC STRUCTURES

In spite of the wealth of material, work with inorganic compounds has been comparatively less extensive than with organic ones. The complex nature of the material and the need for the study of a large proportion of these either in the solid state or in solution is partly responsible for this state of affairs. The field, however, has not been neglected. Leaving out the binary compounds of an ionic type, we may consider the developments in a few select instances.

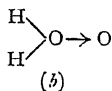
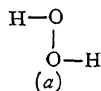
The most exhaustive studies relate to solutions of acids in water, various concentration ranges being generally used. The principal difficulties in the interpretation of the results arise from two causes: considerable changes in the dielectric constant of the solutions have to be expected with large changes in concentration of solute; the hydrogen ion in solution is invariably solvated. Also it is difficult to differentiate between ion-pairs in concentrated solutions and a highly polarised covalent bond that is often postulated in some cases. A limitation in most of the interpretations is the tendency to assume that water remains unaffected by the solute.

Halides of different groups have been extensively studied. All the halides of the formula XY₃ in the fifth group that have been studied show the expected Raman lines on the basis of a pyramidal structure while in the case of boron trihalides, evidence of the planar structure was obtained by studying isotope shifts. The cases of phosphorus pentachloride and of aluminium chloride are of particular interest. Raman spectral studies of the first compound³³ clearly indicated the presence of PCl₄⁺ in the solid which is now known from other physical studies to be essentially PCl₄⁺ PCl₆⁻.¹⁰ Anhydrous aluminium chloride which is known to occur normally in the dimeric form has been assigned the D_{2h} symmetry by Kohlrausch though the evidence from Raman and infra-red spectra have not been without difficulties.²⁰

Among structures that have intrigued both physicists and chemists is that of diborane. Several alternatives have been proposed: (i) the structure proposed by Pauling involving a resonance hybrid with direct bond between

the two boron atoms: (ii) the structure proposed by Bell⁵ involving a hydrogen bridge structure; and (iii) a protonated double-bonded structure suggested by Pitzer.³⁸ While some type of hydrogen bonding is now fairly established, neither Raman Spectra nor infra-red spectra enable any unequivocal decision between the Bell and the Pitzer models.

Hydrogen peroxide has also presented difficulties with the possible structures:



Penney and Sutherland have shown from an analysis of the characteristic frequencies that the puckered dihydroxylic form (c) in which the hydroxy groups are in perpendicular planes, best represents the molecule.³⁶

Nitric acid is one of the most thoroughly investigated compound. Earlier work has been no doubt useful as a guide but the nature of the "unionised" form has been uncertain. The exhaustive investigations of Ingold and co-workers²¹ on pure nitric acid and in solutions has enabled a complete interpretation of the spectral behaviour in accord with the model of Maxwell and Moseley³² (Fig. 4).

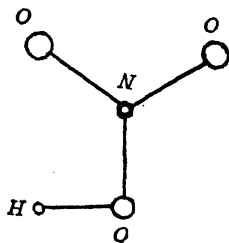


FIG. 4. Structure of Nitric Acid.

It may be mentioned here that Raman Spectra of the monomeric form of cyanic acid and of thiocyanic acid, as also hydrazoic acid, indicate the presence of an N-H bond in all three rather than the isomeric structure with O-H or S-H bond as the case may be.

Raman Spectra studies have also been of use in the study of ions of the type XY_3 and XY_4 besides various complexes.

§ 3. ANALYTICAL APPLICATIONS

The simplicity of technique and the individuality of Raman Spectra have enabled the gradual use of Raman Spectra in the qualitative and quantitative analysis of mixtures of closely related compounds which could not be

handled by the usual chemical means. Other physical methods often involve expensive equipment and, where isomeric hydrocarbons are involved, unsatisfactory in use.

In the present brief survey it is not possible to make any detailed reference to improvements in the techniques. These have been designed to improve the intensity of the scattered radiation, cutting out the background illumination and the development of photoelectric and similar devices for recording as well as detecting Raman line.^{18,27} One of the most interesting devices is that of a multiple reflection technique which has made the study of gases more feasible than before.⁴⁵

Quite early in the development of the subject, interesting applications have been noticed in the perfumery industry. The relative amounts of isopropylidene and of isoprenyl isomers in the terpene series, the composition of both natural and synthetic mixtures of the terpene hydrocarbons and similar compounds have been studied extensively in France.

Raman Spectra have been particularly useful for the study of unstable compounds which cannot be frozen out as in the case of nitrogen pentoxide in nitric-sulphuric acid mixtures, nitric-perchloric acid mixtures and similar instances.^{8,21} By a measurement of intensities of persistent lines, Goubeau has been able to detect and make a rough estimate of the relative amounts of benzene, toluene and the xylenes¹⁷ while Piaux estimates the amounts of *cis* and *trans* pentenes obtained by the dehydration of pentanol using the specificity of their Raman Spectra.³⁷ Initial work on aromatic hydrocarbon mixtures dealt with binary mixtures but more recent work has enabled the estimation of as many as eight aromatic compounds with an accuracy of 2%.⁴⁰

The method is particularly handy where the components of a mixture are not affected by intermolecular forces. This is the case with hydrocarbons and both qualitative and quantitative are possible with comparison spectra of the pure hydrocarbons. Fenske and others have prepared a very useful collection of Raman spectrograms for over 350 compounds.^{9,15} Recently, a monograph has appeared¹ devoted solely to the analytical applications of the Raman Effect.

§ 4. CHARACTERISTIC FREQUENCY AND CHEMICAL REACTIVITY

While Raman Spectra have not been as useful as ultraviolet absorption or infra-red studies

in the identification of transient molecules, it is nevertheless an important tool in the correlation of reactivity with structural influences.

The concept of mesomerism or resonance has been introduced to account for the behaviour of a variety of compounds^{19,35} and Raman Spectra have been helpful in the elucidation of some of these structures. Thus Raman spectral evidence has substantiated the symmetry of the nitro group, the carboxyl, nitrate and carbonate ions and the linear structure of carbon dioxide and carbon disulphide. Both infra-red and Raman Spectra have been used in following the course of polymerisation reactions where the mesomeric structure of a butadiene system is progressively replaced by a system of isolated double bonds. The precision of measurements now possible has enabled a study of the influence of the structure of the initial polyenes on the course of polymerisation. A close correlation between the $C=C$ double bond frequency and the activation energy of the reaction as well as the relationship between the carbonyl frequency and activation energies for both acid and alkaline hydrolysis of carboxylic esters is noticeable.^{2,3} Addition and substitution reactions and the relationship with characteristic vibrations has been the subject of study by Duchesne.¹⁴

In dealing with reactivity, one has to reckon more with excited structures than with molecules in the ground state and Duchesne has indicated the problem taking the relative rate of addition of hydrogen bromide to ethylene and acetylene as examples.¹³ It is interesting to note in this connection that the infra-red studies of Ingold has recently shown that in its excited state, acetylene has a non-linear form. The subject deserves further study.

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COMMONWEALTH SCIENTIFIC CONFERENCE, AUSTRALIA (1952)*

THE object of the Conference was to consider how the fullest co-operation between Government civil scientific organizations in the British Commonwealth could be achieved and to make recommendations for the approval of the governments represented.

The Conference was attended by 34 senior scientists from the United Kingdom, Canada, Australia, New Zealand, South Africa, Pakistan, Ceylon, Southern Rhodesia and the Colonies together with an observer from the U.S.A. A cable of good wishes was received from the Government of India.

The Conference reviewed several aspects of common interest in a problem, the relationships existing throughout the Commonwealth were now so close as to make collaboration between research institutions in the various countries intrinsically no more difficult, apart from the geographical separation involved, than collaboration between research institutions in the same country; and therefore, that any machinery set up for furthering collaboration should aim at supplementing rather than discouraging or replacing the numerous direct contacts between scientists which had already led to most desirable results.

Since scientific research plays an ever larger part in the affairs of all nations, the Conference felt that the effectiveness of the organization of national research was becoming of increasing importance. In discussing this the Conference, while agreeing that Government research organizations must vary in their actual form from country to country, was able to enunciate certain general principles, based on experience, as a possible guide to nations setting up such bodies for the first time. For example, the Conference considered that the responsibility for their direction should be in the hands of a Council, Executive Committee, or Board consisting of senior scientists covering one or more of the fields of industry, agriculture and medicine, with whom representatives of these or other interests might be associated as appropriate. These governing bodies should have a strategic function and recommend broad lines of policy, including the distribution of scientific effort within the organization and, therefore, the main financial allocations within the total sum of money made available by governments. They should be directly responsible to a Minister, appointed for the purpose by the Govern-

ment, but should be free from all other political control and influence. Once the broad lines of policy had been determined, the executive officers of the organizations should have complete responsibility for their general implementation, as should the Directors of laboratories for the conduct of the actual research. The organization should have power to appoint to its staff the most suitable men of high scientific ability and promote them as individuals judged in terms of their scientific merit and achievement.

It was emphasized that a national research organization could not develop healthily in isolation. The strength of a nation's scientific effort depends primarily on the supply of trained research workers from the Universities and the existence of schools of fundamental research which form a country's scientific capital. On the one hand, therefore, national research organizations must be closely associated with Universities. On the other hand, in order that their research programmes may be closely related to national needs and results quickly applied, they must work closely with industry, agriculture or medicine. The Conference considered that the first responsibility of a national research organization should be to survey the problems whose investigation could contribute most effectively to the welfare, prosperity, or health of the people and thereafter determine research priorities.

The Conference reviewed several aspects of the problem of helping under-developed countries. It is clear that the advance of medical science by reducing infant mortality and prolonging life in countries short of food and already suffering from population pressure, could have the effect of lowering rather than raising the general standard of living. Similarly, improvements in agriculture could easily be offset by population increase. The Conference believed that this constituted one of the major world problems in which science had a large part, and consequently recommended that the Governments of the British Commonwealth should seek joint action with the Food and Agriculture, and World Health Organizations of the United Nations to examine the relationship between world food supplies, agricultural systems, rising populations and the influence of medical research in improving nutrition and prolonging life.

The Conference considered the problem of supplying the experts now required for helping under-developed countries through the schemes of United Nations Agencies and the Colombo

* Summary of Report published by H. M. Stationery Office, London, 3s. net.

Plan. It appeared to the Conference that many of the scientific specialists now required were of types already scarce in all countries. At the same time the positions under the Technical Assistance Schemes were frequently of short duration and would, therefore, only appeal to scientists if on the termination of their work overseas they could return to normal duties. It was accordingly suggested that scientific insti-

tutes in the Commonwealth countries should deliberately provide an extra number of posts for specialists in subjects much sought after for overseas work, on the assumption that this would be a continuing demand and that a proportion of their staff would normally be overseas. The Conference recommended that a thorough study of this problem should be made on a Commonwealth basis.

BCG CAMPAIGN IN INDIA

THE annual death roll due to tuberculosis in India works out to about five lakhs. This means that one person dies of the disease every minute in this country. Over and above this the disease disables others at five times that rate.

Mass BCG vaccination campaign has been accepted all over the world as one of the most important measures for fighting tuberculosis. Over 50 million persons have been vaccinated with BCG all over the world. In India alone 13.1 million persons have been tuberculin-tested and 4.2 million BCG vaccinated upto the end of December 1952.

But it is estimated that in India there are about 17 crores of persons below the age of 20 years, most of whom need BCG vaccination. For covering this population, the Government of India has entered into a tripartite agreement with the World Health Organisation and the United Nations International Children's Emergency Fund. According to the agreement, the World Health Organisation will provide certain

international staff for starting mass campaigns in the various States. The UNICEF will provide supplies consisting of transport vehicles, publicity equipment and vaccination equipment.

The Government of India will provide a Central BCG Organisation for co-ordination of public education and statistical work, meet the subsistence allowance and travel expenses of international personnel engaged in BCG work and will distribute the tuberculin and the vaccine required for the project free of cost to the States. The State Governments on their part will have to step up the number of BCG teams in the field, and carry out the field work in their areas.

The BCG vaccine and tuberculin solution used in the campaign to-day come from the BCG Laboratory set up by the Central Government in the King Institute, Guindy, Madras, staffed by experts who received specialized training at the State Serum Institute, Copenhagen.

VIOMYCIN, NEW ANTIBIOTIC AGAINST TUBERCULOSIS

A NEW antibiotic, viomycin, has proven effective in treating tuberculosis cases which have become resistant to streptomycin, according to Dr. Howard Payne, Professor of Medicine at Howard University, Washington, D.C.

Reporting on the treatment of 35 cases of pulmonary tuberculosis with a combination of viomycin and PAS (*para*-aminosalicylic acid), Dr. Payne observes that streptomycin-resistant organisms are sensitive to viomycin, and patients harboring such organisms improve under intermittent viomycin treatment. Even in cases not resistant to streptomycin, he found the new drug clearly effective. Its toxicity was found negligible in the dosages used.

As a control to the group of 35 patients,

Dr. Payne maintained 24 others on the widely used combination of PAS and dihydrostreptomycin. After observing both groups over a period of from six to ten months, he concluded that while improvement was more marked in patients treated with streptomycin-PAS, the effectiveness of viomycin-PAS is definite and demonstrable. This was particularly noticeable in seven streptomycin-resistant cases.

The development of resistance to streptomycin by tuberculosis organisms is one of the chief stumbling blocks in current therapeutic research on the disease. The clinical use of viomycin would therefore seem to be particularly welcome, if it proves as good as it promises to be.

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THERMAL DIFFUSION AND FORCE BETWEEN UNLIKE MOLECULES

FOLLOWING the discovery of the phenomena of thermal diffusion by Enskog and Chapman, much theoretical and experimental work has been done, which has been conveniently summarized by Chapman and Cowling,¹ and more recently by Grew and Ibbs.² As is well known, the coefficient of thermal diffusion is far more sensitive to the type of molecular interaction than the three elementary gas coefficients, and hence its use for determining the laws of molecular interaction would give far more accurate values.

Assuming the validity of the Lennard-Jones 12:6 potential energy function,

$$E(r) = \lambda r^{-12} - \mu r^{-6}, \quad (1)$$

or in the alternative form

$$E(r) = 4\epsilon [(\tau_0/r)^{12} - (\tau_0/r)^6], \quad (2)$$

we have calculated the intermolecular force constants ϵ_{12} (the minimum potential energy) and r_{12} , the separation for zero interaction energy, by utilizing the experimental data on thermal diffusion and inter-diffusion. It may be pointed out that the previous workers on the thermal diffusion of gas mixtures have assumed approximate values for these constants based on certain empirical formulæ which are not at all correct. Our calculations are however exact and yield the force constants within the limits of accuracy of the experimental data. The values so obtained for a few gases are given in Table I.

These values of ϵ_{12} and r_{12} have been used to yield the values of μ_{12} and λ_{12} with the help of equations (1) and (2). These are given in Table II.

It is of great interest to find how the force constants μ_{12} and λ_{12} or ϵ_{12} and r_{12} depend on

the force constants μ_{11} , μ_{22} , λ_{11} , λ_{22} for like molecules. From a discussion of the dispersive and repulsive energies of molecular interaction, it can be shown that

$$\epsilon_{12} r_{12}^6 = 2(\epsilon_{11} \epsilon_{22} r_{11}^6 r_{22}^6)^{1/2} (I_1 I_2)^{1/2} / (I_1 + I_2) \quad (3)$$

$$\mu_{12} = (\mu_{11} \mu_{22})^{1/2} \cdot 2 \cdot (I_1 I_2)^{1/2} / (I_1 + I_2) \quad (4)$$

$$\lambda_{12} = (\lambda_{11} \lambda_{22})^{1/2} (r_{12}^3 / r_{11} r_{22})^{1/2} \cdot 2 \cdot (I_1 I_2)^{1/2} / (I_1 + I_2) \quad (5)$$

where I_1 , I_2 are the ionization potentials. These equations show that the assumptions $\epsilon_{12} = (\epsilon_{11} \epsilon_{22})^{1/2}$ and $r_{12} = (r_1 + r_2)/2$ hitherto made by workers in this field have no theoretical justification. Tables I and II show that our equa-

TABLE I

| Gas pair | ϵ_{12}/k Expt. | ϵ_{12}/k (Eqn. 3) | ϵ_{12}/k Geom. Mean | $r_{12}(\text{\AA})$ Expt. | $r_{12}(\text{\AA})$ (Eqn. 3) | $r_{12}(\text{\AA})$ Arith. Mean |
|--------------------------------|----------------------------|-------------------------------|---------------------------------|-------------------------------|----------------------------------|-------------------------------------|
| H ₂ -N ₂ | .. 46.53 | 51.42 | 53.86 | 3.779 | 3.795 | 3.784 |
| H ₂ -O ₂ | .. 59.81 | 50.99 | 60.67 | 3.154 | 3.108 | 3.206 |
| H ₂ -A | .. 56.41 | 58.21 | 64.47 | 3.541 | 3.288 | 3.196 |
| H ₂ -CO | .. 52.02 | 50.28 | 57.55 | 3.714 | 3.745 | 3.707 |
| He-A | .. 20.05 | 27.04 | 27.45 | 3.041 | 3.049 | 3.002 |

TABLE II

| Gas pair | $\mu_{12} \times 10^{60}$ Expt. | erg. cm. ⁶ (Eqn. 4) | $\lambda_{12} \times 10^{104}$ Expt. | erg. cm. ¹² (Eqn. 5) |
|--------------------------------|------------------------------------|-----------------------------------|-----------------------------------------|------------------------------------|
| H ₂ -N ₂ | 35.4 | 39.1 | 4.91 | 5.43 |
| H ₂ -O ₂ | 34.8 | 35.5 | 3.09 | 3.77 |
| H ₂ -A | 35.8 | 37.0 | 4.15 | 4.28 |
| H ₂ -CO | 41.4 | 40.0 | 5.99 | 5.80 |
| He-A | 11.6 | 11.7 | 0.91 | 0.89 |

tions give much better agreement with the experimentally determined values than the hitherto assumed empirical relations.

Using these force constants thus obtained from thermal diffusion and equation (3), the transport coefficients of certain binary gas mixtures have been calculated. It has been found that the agreement between theory and experiment is quite satisfactory, thereby proving the correctness of the force constants determined by us.

Detailed reports are being published elsewhere.

Dept. of Physics,
Lucknow University,
January 19, 1953.

B. N. SRIVASTAVA.
M. P. MADAN.

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MAGNETIC STUDY OF SOME FORMS OF CORUNDUM

CORUNDUM (an oxide of aluminium, Al₂O₃) is known as white sapphire in its pure form. Admixture of small quantities of chromic oxide imparts a beautiful red colour and the specimen is then well known in gemmology as ruby. Since Cr₂O₃ is isomorphous with Al₂O₃, chromium may be assumed to take the place of aluminium in the crystal. Similarly the blue colour of sapphire is due to the presence of titanium in the form of TiFeO₃.

The invention of the Verneuil furnace in 1904 has made the production of large quantities of transparent synthetic corundum possible.¹ Several physical properties of these specimens very closely resemble those of the corresponding natural stones. A magnetic study of synthetic and natural forms of ruby and white sapphire was undertaken from this point of view.

The principal magnetic susceptibilities were studied by Krishnan's critical torsion method.³ The mean specific susceptibilities were obtained with the Curie balance. α -corundum crystallizes in the rhombohedral division of the hexagonal system.⁴ The rhombic axis is also the optic axis of the crystal. The values of the specific susceptibility parallel and perpendicular to this axis are tabulated below.*

| | χ_{\perp} | χ_{\parallel} | $(\chi_{\perp} - \chi_{\parallel})$ |
|--------------------------|----------------|--------------------|-------------------------------------|
| Synthetic ruby | +0.41 | +0.38 | 0.03 |
| Synthetic white sapphire | -0.21 | -0.25 | 0.04 |
| Natural ruby † | -0.15 | -0.20 | 0.05 |

The values of the anisotropy were found to be nearly equal. The principal susceptibilities of natural sapphire could not be determined since crystals of suitable size were not available. The magnetic properties of α -corundum are found to be similar to those of calcite, which is also a negative crystal and which crystallizes in the same division. The principal susceptibilities of the O₃ group (the centres of the oxygens being at the vertices of an equilateral triangle of side 2.3 Å) are found to be -29.1 (normal to the plane) and -34.2 (in the plane) per gram molecule of alumina. The anisotropy is of the same order of magnitude as the values obtained with CO₃ and NO₃ groups.⁵

The results obtained with several specimens showed that the mean specific susceptibilities of synthetic and natural white sapphire (-0.22 and -0.35) were close to the value of -0.376

obtained by adding the ionic contributions. On the other hand, synthetic ruby was strongly paramagnetic (nearly 0.40) while the specimens of natural ruby of nearly the same red colour were all diamagnetic (-0.16). These results are in complete accord with the results of chemical analysis that in synthetic ruby, there is far greater percentage of chromic oxide than in the natural stones.² Our calculations give 0.82 per cent. in synthetic ruby and 0.27 per cent. in the best available natural specimens.

Full details will be published in the *Journal of the University of Mysore*.

Central College, S. RAMACHANDRA RAO.
Bangalore, M. LEELA.
February 17, 1953.

* All χ values are given in 10^{-6} unit.

† From the richness of colour these were the best stones available with the jewellers.

1. Herbert Smith, *Gemstones*, 1950, p. 276. 2. *Ibid.*, p. 184. 3. Krishnan and Banerjee, *Phil. Trans. Roy. Soc.*, 1935, **234**, 267; see also (5), 30. 4. Wyckoff, *The Structure of Crystals*, A.C.S. Monographs, 1931, 254.
5. Nilakantan, *Studies in Crystal Magnetism*, Thesis, Madras, p. 44.

CONDUCTOMETRIC ESTIMATION OF CERIUM IN DILUTE CEROUS CHLORIDE AS OXALATE

For the quantitative estimation of the rare earths as oxalate, the acidity of the solution requires careful adjustment.¹ Further, the rare-earth oxalates, e.g., that of cerium, are not completely insoluble even in the presence of excess oxalic acid.² In view of the success of the conductometric method of estimation, as oxalates of Ca, Ag, Cu, Co, Ni, etc.,^{3,4} it was of interest to extend the method to cerium and other rare earths.

Conductometric titration of 10.0, 5.0 and 3.3×10^{-4} M. cerous chloride (Merck's guaranteed extra pure), against 0.01 M. ammonium oxalate and oxalic acid (Analar samples), was carried out at $30 \pm 0.05^\circ \text{C}$. in a Pyrex conductivity cell with platinum electrodes using a Pye's modified Post Office Box of d'al resistance type. Air-free conductivity water was employed for preparing the various solutions. The results obtained are represented in the graph where the conductivity, corrected for dilution, is plotted against the volume of titrant added.

It is seen from the table that the conductometric method of estimation as oxalate, is applicable to cerium in cerous chloride, in dilute

solution. This method is more advantageous than the ordinary chemical methods since in

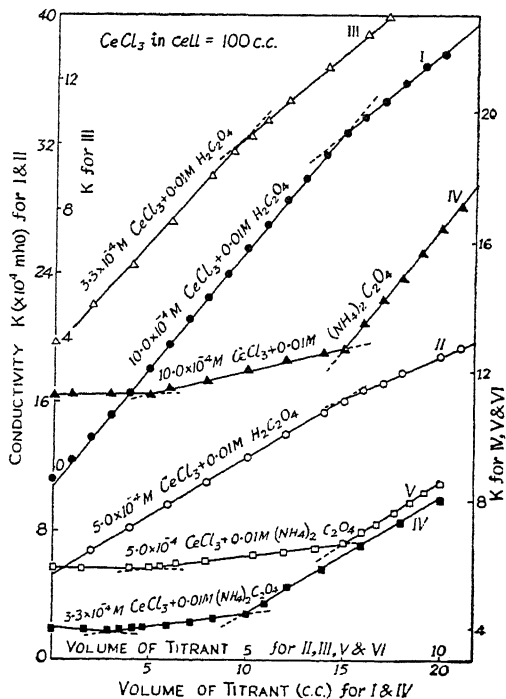
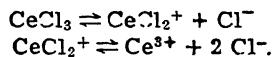


TABLE
Conductometric Estimation of Cerium in Dilute
Cerous Chloride as Oxalate
CeCl₃ taken in the cell = 100 c.c.
Temp. $30 \pm 0.05^\circ \text{C}$.

| Concn. of CeCl ₃ 10 ⁻⁴ M | Am. oxalate for complete pptn. of Ce as Ce ₂ (C ₂ O ₄) ₃ c.c. | Observed am. oxalate for complete pptn. c.c. | Oxalic acid for complete pptn. of Ce as Ce ₂ (C ₂ O ₄) ₃ c.c. | Observed oxalic acid for complete pptn. |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 10.0 | 15.00 | 15.0 | 15.00 | 15.0 |
| 5.0 | 7.50 | 7.5 | 7.50 | 7.5 |
| 3.3 | 5.00 | 5.0 | 5.00 | 5.0 |

large dilution the latter fail.⁵ The CeCl₃—(NH₄)₂ C₂O₄ curves exhibit two breaks in every case, when Ce³⁺ : C₂O₄²⁻ :: 2 : 1 and 2 : 3 respectively. This might result from two-stage ionisation of cerous chloride, viz.,



The reactions occurring on gradual addition of ammonium oxalate to cerous chloride would be :

indicate a S-S bonding¹³ with D_{2h} symmetry of the molecule. This is indeed suggestive of resonance between (II) and (III).

The greater reducing power of (V) [which is identical with (III)] over (VI) and (VII) is evidently on account of its greater unsaturation with respect to oxygen. Its superiority in this respect over (IV), however, is probably due to a different reason, viz., the decomposition of (IV) into elementary sulphur which coagulates easily and forms bigger aggregates, impairing its power to reduce, while the radical -S-OH produced from (III) has relatively greater stability and solvation and therefore is more effective as a reducing agent.

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Banaras Hindu University,
October 25, 1952.

of about 1 cm. and immersed about 3 cm. under the surface of water. The rotation of one of the electrodes also kept the medium agitated, thereby avoiding local effects.

With the above conditions very little heat and dissociation of the medium were produced. After the passage of the discharge for a few minutes a translucent light-yellow pink colour appeared indicating the formation of the sol which was found to be unstable and coagulated if left overnight.

Thanks are due to Professors A. C. Chatterji and P. N. Sharma of Lucknow University, for their kind help and permission to use their laboratory.

Nizam College,
Osmania University,
Hyderabad-Dn.,
November 26, 1952.

INDRA SANGHI.

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CLOUDINESS OF PLAGIOCLASE FELSPARS OF DOLERITE DYKES NALLAMBAKKAM (MADRAS)

PICHAMUTHU¹ in an interesting note on the clouded feldspars of basic dykes in the charnockitic area, described clouded feldspars of either brown or grey colour and ascribed the cloudiness to very fine inclusions in the form of specks or tiny rods. The present writer while studying the dolerite dykes cutting through the charnockites in the area south of Pallavaram came across interesting cases of clouded feldspars, the details of which are given here.

Two basic dykes, occurring within a mile south of Nallambakkam (80° 7'; 12° 51'), run east-west and cut across the charnockites which roughly trend north-south. They are dark-coloured and medium to coarse-grained.

The microsections reveal plagioclase feldspar and augite in typical ophitic relationship. The plagioclase laths are seen profusely sprinkled with dusty inclusions (probably magnetite) in the body of the crystals, the periphery being free from them. These dusty inclusions impart a clouded and zoned aspect to the plagioclase (Fig. 1). This does not, however, appear to be a case of real zoning in the feldspar crystal. This apparent zoned aspect is typical when the plagioclase is enclosed by pyroxene. Aggregates of plagioclase laths out of contact with the pyroxenes do not as a rule exhibit this

ELECTRO COLLOIDATION OF COPPER

PREVIOUS attempts to prepare metal sols by using low tension alternating discharge have been made by Kraemer and Svedberg.¹ We have attempted to prepare a pure copper sol by using a rotating electrode and a high-frequency H.T. discharge (about 60 kilovolts) obtained from a Koch and Sterzel X-ray apparatus. The dispersing medium used was 400 c.c. of conductivity water (conductivity 2.0 gemmhos) at 22° C. contained in clean Pyrex beaker. The electrodes used were two pure copper metal rods of 5 mm. diameter, one of which was about 5 cm. longer than the other. The longer electrode was bent at right angles at the lower end, which was kept horizontally immersed in water. The other electrode was rotated by a properly insulated half h.p. motor dipped in water. Thus, the two electrode ends were at right angles to each other with a spark gap

"zoned" aspect, though they are disseminated with inclusions in a very irregular manner. In addition to the dusty inclusions some of the clouded feldspars show acicular inclusions of apatite, which are developed mostly parallel and rarely perpendicular to the composition planes. The twin lamellae of the plagioclase continue throughout the laths unaffected by the inclusions. The augite adjacent to the plagioclase has similar dusty inclusions concentrated along its margin.



× 50

In the Nallambakkam area the feldspars of the charnockites into which the dykes are intruded, are altogether devoid of such dusty inclusions.

Pichamuthu has, after McGregor, ascribed this cloudiness to regional- or contact-thermal metamorphism at a later date. Yaacow Bentor² explained the zoning of clouded plagioclases in some volcanic rocks to be due to autoresorption in the grain with an albitic core and an anorthitic border, in between which the clouded zone appeared. This explanation does not satisfy the present observation, as the anorthite content of the clouded and non-clouded parts of the plagioclase is just the same. The possibility of the cloudiness being an original feature of the feldspar crystallisation period or a deuteric effect at a late stage cannot be entirely ruled out. The observation that the augites in proximity to the feldspars contain along their margin similar dusty inclusions, whereas the margins of the feldspars adjacent to the augite are devoid of them, may however perhaps be ascribed to metamorphic diffusion of these inclusions from the feldspars.

The author is grateful to Prof. C. Mahadevan

for kind help and suggestions throughout the work.

Dept. of Geology, A. BHASKARA RAO.
Andhra University, Waltair,
February 6, 1953.

1. Pichamuthu, C. S., *Curr. Sci.*, 1951, **20**, 9. 2.
- Yaacow K. Bentor, *Sch. Min. Und. Petr. Mitt.*, 1951, **31**, 2.

ON THE OCCURRENCE OF *DISTICHOPLEX BISERIALIS* IN THE PONDICHERRY AREA (S. INDIA)

It is now well known from the study of Foraminifers that there is undoubtedly an Eocene series occurring in continuation of, and overlying, the Cretaceous rocks in the Pondicherry area. This conclusion, first reported in 1939,^{1,2} is now further confirmed by the presence, which I have just noticed, of the characteristic Eocene alga, *Distichoplex biserialis* Diet. in sections of one of these Pondicherry limestones. The range in time of this fossil is from Palaeocene to Upper Eocene. The exact age of this *Distichoplex*-bearing rock in the Pondicherry area will have to be determined from the study of the other associated fossils. This work is under progress.

Dept. of Geology, L. RAMA RAU.
Central College, Bangalore,
February 19, 1953.

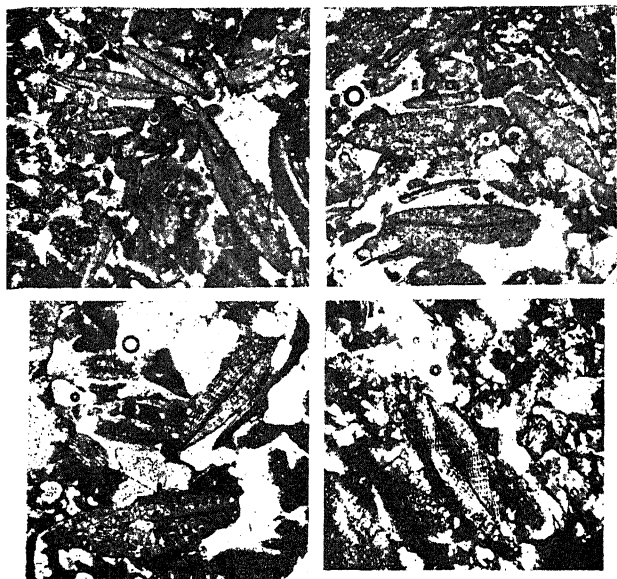
1. Rama Rau, L., *Curr. Sci.*, **8**, No. 4, 166.
2. Furon and Lemcine, *C. R. Ac. Sc.*, **207**, pp. 1424-26.

MORE ORBITOIDS FROM THE CRETACEOUS ROCKS NEAR ARIYALUR (S. INDIA)

In the course of a preliminary examination of some fossiliferous rocks from the Ariyalur area collected by my colleagues, Messrs. M. G. Chakrapani Naidu and C. Gundu Rao during a recent geological excursion to the area with a party of students, I find that one of the rocks (a sandstone exposed in the bed of the Kallar river, about 3 miles east of Ariyalur) is of outstanding interest on account of its foraminiferal contents. Sections of this rock reveal the abundant occurrence of Orbitoids together with several other foraminifers; and the entire assemblage is both striking and impressive as can be seen from the photo-micrographs reproduced in Fig. 1.

This material is being taken up immediately for the detailed study of these foraminifers

and their comparison, not only with the Orbitoids already described from other parts of the Ariyalur formation¹ but also with the more interesting and important Lower Eocene fora-



miniferal fauna recently discovered in the Pondicherry area.² From what we know of such Cretaceous-Eocene foraminiferal studies in other parts of India and elsewhere, there is no doubt that this investigation from the similar beds of South India will lead to most interesting and important results.

Dept. of Geology, L. RAMA RAU.
Central College, Bangalore.
March 3, 1953.

1. Narayana Rao, S. R., *Jour. Mys. Uni.*, 1941, 2B, Pt. 9. 2. Rama Rao, L., *Curr. Sci.*, 1939, 8, No. 4.

PROCESSING OF FRESHLY DEPOSITED COPPER POWDER

FRESHLY deposited copper powder (for use in powder metallurgy) is prone to easy oxidation during air drying, if dried in the ordinary way. A number of methods, such as vacuum drying,¹ drying in a reducing atmosphere,² washing the powder with solutions of potassium tartrate,³ and stearic acid,⁴ have been tried with varying degree of success, in order to prevent oxidation during drying.

During the studies of the deposition of copper powder, the authors found that a number of reagents serve as anti-oxidants during drying, and that the powder maintains its dull red lustre

for a long time even when stored under humid conditions. Among a number of reagents tried, phosphoric acid, pyrophosphoric acid, citric acid, tartaric acid and sodium-potassium tartrate were found to be quite suitable. A 0.5 per cent. solution of the reagent was found to be the best. Copper powder was prepared from a sulphate-bath as well as a (cuprous) chloride bath and the processing of the deposited powder was as follows: After the powder was washed free from the adhering electrolyte, it was washed with a 0.05 per cent. solution of sodium carbonate (to remove the traces of the acid) and was washed again with water to remove the carbonate. The powder was finally washed with one of the reagents mentioned and then dried in an air oven at 80° C.

It has been observed that phosphoric acid in particular is the best reagent and with this as well as the pyrophosphoric acid it is not necessary to use a sodium carbonate wash. Citric acid, tartaric acid, and sodium-potassium tartrate are good reagents for copper powder deposited from the sulphate bath and a sodium carbonate wash is necessary. Otherwise the powder gets slowly oxidised during drying and turns dark or even black in some cases.

Dept. of Chem. Technology, S. SUBRAMANYAM.
University of Bombay, G. S. TENDOLKAR.
November 1, 1952.

1. U. S. Patent, 1, 894, 924. 2. Cordiano, J. J., *Trans. Electrochem. Soc.*, 1944, 85, 97. 3. *B.I.O.S.*, 706, 4. Tyrrel, H. J. V., *J. Inst. Metals*, 1949, 76, 17.

DEPHOSPHORISATION OF ALLOYS UNDER GASEOUS ANNEAL

In a previous communication,¹ some results on the dephosphorisation of white cast iron have been reported and discussed on the basis of the free energies of phosphorus, molecular hydrogen and phosphine. As was to be expected, no appreciable dephosphorisation could be observed on heating small blocks (15 mm. × 8 mm. × 8 mm.) prepared from a sample of white cast iron (C, 3.08 per cent.; Si, 0.88 per cent.; Mn, 0.216 per cent.; P, 0.21 per cent. and S, 0.10 per cent.) in a current of hydrogen containing 1.2 per cent. by volume of moisture. The dephosphorisation of an alloy, however, depends on a number of factors besides the heterogeneous chemical reaction between hydrogen and the solid and/or the liquid alloy. The reactants, hydrogen (and/or moisture), and phosphorus have to come in mutual contact and the products of the reaction have to be removed from the zone of the reaction in order that

equilibrium may not be established. In view of the above considerations, the loss of phosphorus, if any, on annealing powdered phosphor-copper (P, 14.0 per cent.) for different lengths of time upto 8 hours at temperatures 500°, 800°, 900° and 1,000° C. under a current (240 c.c. per minute) of dry hydrogen and also hydrogen containing 1.2 per cent. by volume of moisture, has been determined. The results so far obtained have been summarised in Table I.

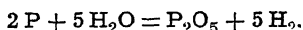
TABLE I

Removal of Phosphorus from Phosphor-Copper (P, 14.0%) on annealing in Hydrogen and Nitrogen

| Temperature (° C.) | Time (hours) | Phosphorus content on treatment with | |
|-----------------------|-----------------|-----------------------------------------|----------------------------|
| 500 | 8 | Dry H ₂ -13.9 | Moist H ₂ -12.6 |
| 800 | 6 | 14.0 | 12.0 |
| " | 8 | 13.8 | 11.9 |
| 900 | 2 | 13.9 | 12.8 |
| 1000 | 1 | 13.5 | 11.9 |
| " | 2 | 13.3 | 11.0 |
| " | 1 | Dry N ₂ -13.6 | Moist N ₂ -12.3 |
| " | 2 | 13.4 | 11.9 |

The data cited in Table I indicate that except at 1,000° C. dry hydrogen does not seem to remove any appreciable amount of phosphorus from phosphor-copper but on the other hand, moist hydrogen brings about definite dephosphorisation of the alloy. Similar experiments were carried out using nitrogen and the results compared with those obtained with hydrogen.

It will appear from the data reported at the end of Table I that the observed dephosphorisation of phosphor-copper at 1,000° C. on annealing in dry hydrogen can be accounted to a large extent as due to diffusion and volatilisation. Moist nitrogen again seems to be much more effective in bringing about dephosphorisation of the alloy compared to dry nitrogen. It appears that the enhanced dephosphorisation by wet gases compared to dry ones may be accounted for to a large extent by the direct reaction between phosphorus and water as per the equation,



The data also suggest that a very small dephosphorisation probably results from the reaction between phosphor-copper and hydrogen forming phosphorus hydrides. Further work on this point is in progress.

Taking all the facts into consideration, it will appear that dephosphorisation of phosphor-copper in hydrogen involves (i) a loss of phosphorus due to diffusion and volatilisation, and

(ii) a direct interaction between phosphor-copper and hydrogen. Dephosphorisation due to (i) seems to far outweigh that due to (ii). The addition of moisture in the gases enhances the dephosphorisation of the alloy mainly due to its direct reaction with phosphorus and to a minor extent to its interaction with the gaseous products, e.g., P₂O₅ and PH₃ involved.

We take this opportunity to offer our sincere thanks to Dr. S. R. Sen Gupta for his kind interest in the work.

Bengal Eng. College,
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December 24, 1952.

P. C. GHOSH.
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1. Ghosh and Chatterjee, *Trans. Indian Inst. Metals*, 1951, 5. 2. —, *Proc. Indian Sci. Cong.*, 1953, 3, 220.

XYLOSE FROM JUTE STALKS

XYLOSE is obtained from waste cellulosic materials by prolonged action of dilute sulphuric acid. Apricot stones,¹ cottonseed hull,² and corncoals³ have so far been reported to give the highest yields. Very recently, rice husk, paddy straw, groundnut shell, etc., were examined⁴ as probable sources for xylose. In course of a comprehensive investigation on the utility of jute stalk for various purposes, we examined this for production of xylose, and obtained very satisfactory results.

Jute stalk was reported⁵ to yield rather high percentage of total furfural. Samples examined by us were found to contain an equivalent of 18.0% pentoses. Therefore jute stalks were treated on similar lines as the earlier workers for the isolation of xylose. Corn cob xylose was reported⁶ to contain a gummy fraction, which hinders the easy crystallization of the xylose. This was destroyed by a pre-treatment with 1% NaOH prior to acid hydrolysis, without affecting the yield to any great extent. Treatment of jute stalks was therefore carried out under varying conditions.

In one experiment, the powder (50 g.) was boiled with 700 c.c. of the sulphuric acid for two hours, cooled and filtered. The solution was straw-coloured, and was treated with decolourizing charcoal. The clear solution was then evaporated under vacuum to over 80% total solids. It was then cooled and the xylose readily crystallized from alcohol. The yield of xylose was 10.8%.

In another experiment, 50 g. of the powder was pretreated with 700 c.c. of 1% NaOH and then hydrolysed as before, after washing

free of alkali. With this alkaline treatment, the yield decreased to 6.2%. Thus jute stalk xylan appears to contain less of gum, and is more susceptible to alkali treatment. The maximum yield (10.8%) compares very satisfactorily with other rich sources. The recovery is calculated to be nearly 60% of total pentosa, which is better than those recently reported for similar waste materials.*

Dept. of Chemistry,
University of Dacca,
East Pakistan,
December 9, 1952.

N. H. BHUIYAN.
M. H. KHUNDKAR.

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PENICILLIUM NOTATUM AS A SOURCE OF FUNGAL PECTINASE

INVESTIGATIONS have been carried out in the preparation of fungal pectinases for the clarification of fruit juices. Numerous strains of molds (25 in number) comprising of *Penicillia*, *Aspergillia* and *Rhizopus* families have been examined for their pectin degrading action. The molds have been grown on Pectin-dextrose medium (Pectin 2.5%, Ammonium nitrate 2%, dextrose 0.2%, $MgSO_4$ 0.002% and KH_2PO_4 1%) having a pH of 4.0. This study led to the selection of a highly pectinolytic strain which on examination has been classified as *Penicillium notatum* and carries a number CFTRI 1013, in our col-

lection of type cultures. The selected culture has been employed in the present studies in finding out a suitable medium for the production of fungal pectinase.

Penicillium notatum, CFTRI 1013, was grown for four days at room temperature (26-27° C.) in 250 c.c. conical flasks containing different media (see Table I). The growth was good in all the media except No. 8, in which it was fair. The moldy mass was treated with 50 ml. of water and ground with quartz sand in order to aid the enzyme extraction. The ground material was then strained through a cheese cloth and passed through a filter-paper and the solution was made up to a known volume. The enzyme action was determined viscosimetrically¹ and expressed in pectinase units. One unit of pectinase has been defined as that quantity of enzyme which when allowed to react on 25 c.c. of 2.5% papaya pectin buffered to pH 3.5 and at a temperature of 27° C. brings about 30% reduction in viscosity in 30 minutes. The results obtained with various media are given in Table I.

The results in Table I indicate that the lucerne substrate forms the best medium for the production of pectinase by *Penicillium notatum*. Supplementation of this medium with pectin or pectin-rich source such as albedo powder did not improve the pectinase yield. Wheat bran in itself or in combination with lucerne forms a poor medium for the production of pectinase. However, improved yields were obtained when wheat bran medium was supplemented with pectin.

The naturally occurring rich sources of pectin such as fruit juices and the albedo portion of the citrus fruit were tried as culture medium for the growth of *P. notatum* with a view that

TABLE I

| Composition of the Culture Media | | pH | Total recovery in pectinase units |
|----------------------------------|-------------------------------------------------------------------------------|---------|-----------------------------------|
| 1 | 25 ml. of pectin-dextrose medium (see text) | 3.4-3.5 | 100.0 |
| 2 | 10 g. of wheat bran+15 ml. of water | 4.2-4.4 | 33.0 |
| 3 | 10 g. of wheat bran+0.5 g. pectin+15 ml. of water | 4.2-4.4 | 90.5 |
| 4 | 10 g. of powdered lucerne+30 ml. of water | 4.9-5.1 | 750.0 |
| 5 | 10 g. of powdered lucerne+0.5 g. pectin+30 ml. of water | 4.9-5.1 | 600.0 |
| 6 | 25 ml. of orange juice (pH 4.0) | 4.3-4.5 | Negligible |
| 7 | 25 ml. of the fruit juice (<i>Citrus decumana</i>) (pH 4.0) | 4.2-4.4 | do |
| 8 | 5 g. of dried albedo powder*+15 ml. of citric phosphate buffer (pH 3.5) | 3.8-4.0 | do |
| 9 | 5 g. of lucerne+5 g. of wheat bran+20 ml. of citric phosphate buffer (pH 3.5) | 4.8-4.9 | 25.0 |
| 10 | 2 g. of dried albedo powder*+3 g. of lucerne+15 ml. of buffer | 4.0-4.1 | 41.5 |

* Albedo portion of *Citrus decumana*

the mold may yield high concentrations of pectinase but such results have not been realized.

Further work is in progress to find out the optimum conditions for the formation of pectinase by *Penicillium notatum* when grown in lucerne medium.

Our sincere thanks are due to Dr. V. Subrahmanyam for his keen interest in these investigations.

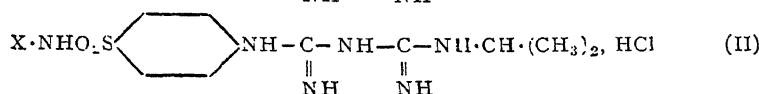
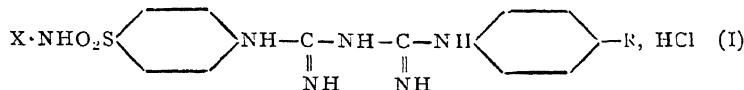
Microbiology & Sanitation Division, B. S. LULLA.
Central Food Tech. Res. Inst., D. S. JOHAR.
Mysore,

December 17, 1952.

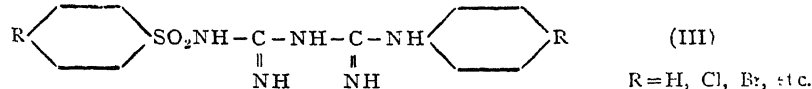
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STUDIES IN SULPHABIGUANIDES: N¹-SULPHONAMIDOPHENYL N⁵-ISOPROPYL-BIGUANIDES AND N¹-ARYLSULPHONYL N⁵-ARYL BIGUANIDES

A NUMBER of sulpha-biguanide derivatives of the type N¹-p-sulphonamidophenyl-N⁵-aryl-biguanides^{1,2,3} (I) and their m-sulphonamido-



X=H, 2-thiazolyl; 2-pyrimidyl etc., R=H, Cl, Br, etc.



phenyl analogues⁴ have displayed feeble anti-malarial activity when tested against *P. gallinaceum* in young chicks^{5,6} and *P. knowlesi* in monkeys.⁵ One of the reasons for their poor anti-malarial activity could possibly be the absence of terminal isopropyl group, which is considered essential for optimum response in this class of compounds.⁷ Above findings and potentiation of each other's anti-malarial activity⁸ in the case of proguanil and sulphadiazine, prompted the synthesis and testing of certain N¹-(m or) p-sulphonamidophenyl-N⁵-isopropyl-biguanides (II).

For the synthesis of these compounds (Type II) isopropylcyanoguanidine (obtained through sodium dicyanamide⁹) was reacted with hydrochlorides of sulphanilamide (m.p. of the products 240° C.), sulphapyridine (254° C.), sulphadiazine (260° C.); sulphathiazol (258° C. with decomp.); sulphaguanidine (236° C.); sulphamerazine (252-53° C.) and 5-chloro-2-meta-

nilamido-pyrimidine (Metachloridine) (272-73° C. with decomp.) in pyridine medium. Sulphapyrazin and sulphaquinoxaline did not react under these conditions probably due to low solubility of their hydrochlorides. Only moderate anti-malarial activity was encountered in case of these compounds (II).

Although a number of sulphabiguanides (Types I & II) have been investigated,¹⁻⁶ no detailed study has been made with N¹-arylsulphonyl-N⁵-aryl (alkyl or heterocyclic) biguanides wherein the -SO₂-group is directly attached to the biguanide chain. Considering the reported activity of sulphanilyl biguanide,¹⁰ some N¹-arylsulphonyl-N⁵-aryl-biguanides (III) have now been obtained by reacting arylsulphonyl-fluorides with aryl biguanides under suitable conditions. N¹-p-chlorophenylsulphonyl-N⁵-p-bromophenyl-biguanide (m.p. 230° C.) and some of its analogues were found to be devoid of activity.

Author's thanks are due to Col. Jaswant Singh, Director, Malaria Institute of India, for his keen interest and encouragement.

Chemistry Laboratory, H. L. BAMJ.
Malaria Institute of India, Delhi-8,
December 29, 1952.

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REACTION BETWEEN BENZILIC ACID AND THIOUREA

THE reaction between benzoic acid and thiourea, gains significance on account of the fact that while both urea and thiourea give 5:5-diphenyl

hydantoin¹ and thiohydantoin² respectively when treated with benzil in presence of alcoholic KOH, only the former yields 5:5-diphenyl hydantoin when heated with benzilic acid.^{3,4} An intimate mixture of benzilic acid and thiourea (equimolecular proportions), when gradually heated to 165-70° C. for about 1½ hours, yields a product which does not contain any 5:5-diphenyl thiohydantoin. The reaction product, on the other hand, is found to contain at least three other compounds. These compounds were separated by using different organic solvents; one of them being insoluble in almost all organic solvents, crystallises from nitro-benzene in colourless fine needles, m.p. 327-28° C. and contains N and S. The other two compounds can be isolated by using alcohol and ether for separation and crystallisation; one melting at 210-11° C., contains N and S and the other melts with decomposition at 197-99° C.

The compound m.p. 197-99° C. (dec.) also contains both N and S and behaves in a peculiar manner. When it is heated above its melting point, hydrogen sulphide is evolved and a liquid is produced having a characteristic odour and of which the colour is intense blue at first but fades to light brown after several hours' standing. On reheating it changes again to blue with a greenish tinge (condensation of the vapours to the intense blue liquid is still visible on some parts of the test tube). The light brown liquid on distillation under reduced pressure (18 mm.) gives a transparent colourless distillate (b.p. 118-20° C.) which shows the same colour changes as the parent liquid, and which can be crystallised into a colourless solid m.p. 30-31° C. It may be mentioned that earlier an intense blue colour was observed by Erlermeyer⁵ when benzophenone chloride was heated with thiourea.

Fuller details of this work will be published elsewhere.

Chemistry Dept., AZIZUR RAHMAN.
Muslim University, Aligarh, M. O. FAROOQ.
December 29, 1952.

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THE CHEMISTRY OF NUTMEG-ARIL (JAY-PATRI)

The nutmeg-aril (*Myristica fragrans* Houtt. N.O.: *Myristicaceae*) was crushed and then extracted with carbon tetrachloride as usual.

On removing the solvent a red coloured oil was obtained. The physical and chemical constants are given below: (Table I, A.).

TABLE I

| Table No. | A | B |
|-----------------------|------------------|--------------------|
| Yield | 26 per cent. | 18 to 20 per cent. |
| Density | 0.9884 at 31° C. | 0.9769 at 28° C. |
| Refractive Index | 1.4850 at 35° C. | 1.4835 at 28° C. |
| Saponification Value | 108.0 | 161-162 |
| Iodine Value | 153-57 | 118-119 |
| R. M. Value | 7.2 | .. |
| Pclenski Number | 0.719 | .. |
| Acetyl Value | 65.0 to 67.0 | .. |
| Acid Value | 3.4 | .. |
| Unsaponifiable matter | 35.0 per cent. | .. |

During the course of the work, it was found that the oil contained a good deal of volatile oil. So the crushed aril was first subjected to steam distillation and the distillate was extracted with ether. On removing the ether a sweet-smelling essential oil was obtained (Yield 6 to 7 per cent.). It is being worked out separately. The aril after steam distillation, was separated from the milky suspension by filtration and dried on water-bath. The dried aril was then extracted with carbon tetrachloride as usual and a red coloured oil was obtained. The oil was treated with petroleum ether when an insoluble resinous mass separated. It was filtered off and the oil thus obtained, after the removal of petroleum ether, was further used for analysis: (Table I, B).

The iodine value and the saponification value are appreciably altered on removal of the essential oil.

The liquid acids (iodine value: 134-36), obtained from the oil, gave a bromo-derivative insoluble in petroleum ether, but not identical with the usual tetra bromo-stearic acid. The bromo-derivative is a soft plastic mass and all attempts to crystallise it from common organic solvents failed. It was, however, obtained in the form of an amorphous powder by dissolving it in benzene and then precipitating it by adding petroleum ether. It melts with decomposition at 127° C.

Further work is in progress and the details will be published elsewhere.

Our thanks are due to Dr. D. N. Solanki for giving us facilities and taking keen interest throughout the work.

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Rajaram College, D. G. PISHAWIKAR.
Kolhapur,
December 24, 1952.

THE FORMATION OF THE DOUBLE SULPHATE OF HAFNIUM AND MAGNESIUM

In a recent communication¹ the formation of the compounds $\text{R}\text{SO}_4\cdot\text{Zr}(\text{SO}_4)_2$, where $\text{R} = \text{Mg}, \text{Zn}, \text{Mn}, \text{Co}$ and Cd was reported. These compounds are hydrolysed completely to give hydrated zirconia.² Under suitable conditions, the yield³ of the compound $\text{MgSO}_4\cdot\text{Zr}(\text{SO}_4)_2$ (a typical example) is increased to almost 100 per cent. and it is possible to extract zirconia from the zircon ore by taking advantage of the formation of this compound. When a similar study was made using hafnium oxide (99.5% pure, free from zirconium), the formation of $\text{MgSO}_4\cdot\text{Hf}(\text{SO}_4)_2$ was indicated. The experimental procedure followed and the data obtained are given in the following paragraphs.

TABLE I

Analytical Data for the Compound $\text{MgSO}_4\cdot\text{Hf}(\text{SO}_4)_2$

| Hafnium oxide | Magnesium sulphate heptahydrate | Sulphuric acid (sp. gr. 1.8) | Hf % | Mg % | SO_4 % | Formula | Yield % of theory |
|------------------|---------------------------------------|------------------------------------|---------|---------|--------------------|----------------------------------------------|----------------------|
| 0.10 g. | 0.40 g. | 40 c.c. | 36.41 | 5.12 | 58.35 | $\text{MgSO}_4\cdot\text{Hf}(\text{SO}_4)_2$ | 86.38 |
| 0.03 g. | 0.40 g. | 40 c.c. | 36.82 | 4.62 | 58.00 | $\text{MgSO}_4\cdot\text{Hf}(\text{SO}_4)_2$ | 82.12 |

$\text{MgSO}_4\cdot\text{Hf}(\text{SO}_4)_2$ requires $\text{Hf} = 36.37\%$, $\text{Mg} = 4.95\%$ and $\text{SO}_4 = 58.68\%$.

0.1 gm. hafnium oxide was dissolved in 40 c.c. of sulphuric acid (sp. gr. 1.8) by heating to fumes. To the clear solution thus obtained 0.4 gm. of $\text{MgSO}_4\cdot 7\text{H}_2\text{O}$ (in the solid state) was added and the mixture was heated again. A clear solution was again obtained which when heated further became turbid indicating the separation of a solid phase. After heating for about ten minutes, the liquid with the precipitate was cooled, filtered through a sintered glass crucible (1 G 3) and washed thrice with sulphuric acid (sp. gr. 1.8). The crucible with the precipitate was heated in an air oven at about 220°C . till the fumes of sulphuric acid ceased to evolve (about an hour). After ascertaining that the washings of the precipitate with absolute alcohol were free from sulphate, the precipitate was dissolved in dilute hydrochloric acid and the solution thus obtained was analysed for magnesium, hafnium and sulphate; hafnium being estimated as dioxide after precipitating it as hydroxide with ammonia in the presence of ammonium chloride.

The above experiment was repeated using 0.03 gm. of hafnium oxide and the data obtained in both these experiments are given in Table I.

The compound $\text{MgSO}_4\cdot\text{Hf}(\text{SO}_4)_2$ is white, hygroscopic and soluble in a little water. However, the aqueous solution gets hydrolysed when diluted with excess of water with the separation of hydrated hafnium oxide. Further work on the preparation and uses of similar compounds is in progress.

The author's thanks are due to the Government of India for the award of a research scholarship.

Dept. of Chemistry,
Inst. of Sci., Bombay, India,
January 25, 1953.

S. R. PATEL.

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ON THE OCCURRENCE OF *HILSA TOLI* (CUV. & VAL.) IN THE RIVER HOOGHLY

Hilsa toli (Cuv. & Val.) is considered to be a marine fish in Indian waters. It is found at the river mouths, but has not been observed ascending rivers, either for spawning or feeding as the allied species, *H. ilisha* (Hamilton).¹⁻⁶ This species is also known to occur in Pakistan, Ceylon, Malay Peninsula, Thailand, East Indies, Formosa, China and Japan, and in some of these countries it has been found to ascend estuaries.^{7,8} Smith⁹ has recorded a regular fishery bearing on the adults of this species in the inland waters of Thailand.

During the course of my fieldwork in connection with the enquiry on the probable role of *Hilsa* in maintaining cholera endemicity in India, I collected specimens of *H. toli* from the river Hooghly at Falta (about 80 miles from the mouth of the river) several times during the months of July and on one occasion from Diamond Harbour (about 69 miles from the mouth of the river) in the month of November this year.* They were obtained from the catches of the fishermen who operate drift nets for

H. ilisha. The specimens examined ranged from 29.4 cm. to 57.5 cm. in length and except in the case of two small specimens all of them had the gonads in either fully mature condition or in advanced stages of maturity. Both males as well as females were represented in the catches in about equal numbers. These fish were presumably, the adults that had ascended the river for spawning. The fish is locally known as *Kajal gouri* (Black beauty) or *Mukh phora* (Burnt face), probably because of the black snout and the dark tinge in the colouration of its body. Hora¹⁰ has recently referred to the "infiltration of coarser varieties of Hilsa" such as the *Mukh phora* into the Gangatic system of rivers in Bengal. Hamilton¹¹ who made extensive collections of fishes of the Hooghly from 1798-1814 has not recorded this fish and the fish traders in Calcutta and Diamond Harbour report that this fish is being caught from the Hooghly only during the last two years. Large quantities caught from the river Rupnarayan have also been brought to Calcutta from Kolaghat during this year, and at present, it is a common item in some of the fish markets in the City. Though I have made regular observations at Baghbazaar (Calcutta) and Nawabgunge (about 18 miles up the river from Calcutta), I have not seen any specimens of *H. toli* in the catches at these two centres. Therefore it appears that they do not ascend the river to any great distance beyond Falta.

It is generally believed that the salinity of the river Hooghly is steadily increasing. Hora¹² discussed in detail how several bottom-living marine fishes have migrated into the river through the bottom wedge of salt-water. He did not observe then the presence of any pelagic marine fishes. In an estuary there is usually a layer of fresh water flowing above the tidal wedge, and the presence of such a zone of fresh water might have obstructed the migration of pelagic fishes from the sea. The observations on the surface salinity of the river water at Cossipore and Garden Reach have shown that there is a definite trend of increasing salinity† in the river Hooghly. *H. toli* is a pelagic fish and its migration into the river now may be due to the increase in salinity of the surface waters. As a result of the rise in the height and force of the tidal wedge, the depth of the fresh water layer may have been diminished considerably and it is likely that this has facilitated the migration of pelagic fishes from the sea.

My grateful thanks are due to Dr. K. V. Krishnan, Officer-in-Charge, Hilsa Fish Enquiry, I.C.M.R., for the facilities offered for making these observations and to Dr. S. L. Hora, Direc-

tor, Zoological Survey of India, for suggestions and help.

Hilsa Fish Enquiry, T. V. R. PILLAY.
Indian Council of Med. Research,
Calcutta,
December 6, 1952.

* After this note was communicated for publication, I have found this fish in the catches of fishermen at Diamond Harbour from January to March, 1953.

† Information kindly supplied by Mr. G. S. Madan, Chief Engineer, Port Commission, Calcutta.

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USE OF IRON ALUM IN IMPROVING ACETO-CARMINE SMEAR PREPARA- TIONS IN CUCURBITS

DURING the course of investigations in Cucurbits, it has been observed^{1,2} that the chromosomes do not take up proper stain in pollen mother-cells, smeared in Belling's aceto-carmine. Attempts to make the permanent smear preparations by fixing them in La-Cour's 2BE & Navashin's chromo-acetic formalin and its modifications followed by Iodine-gection-violet method of staining also failed, as these preparations do not stain the chromosomes uniformly in all the cells and at the same time some cytoplasmic bodies get stained, vitiating the results. Pathak and Singh² had recommended the prefixation of the flower buds in acetic alcohol for 1-24 hours, followed by smearing in aceto-carmine for chromosome studies. This procedure was followed up in our present investigations, embracing a number of species, belonging to different genera, viz., *Momordica*, *Trichosanthes* and *Luffa*, and it was observed that the preparations could be considerably improved if mordanting with 4 per cent. Iron Alum (ferric ammonium sulphate) is done after the buds have been fixed in acetic alcohol, followed by smearing in

aceto-carmine. Excellent preparations at all stages of the meiotic divisions were obtained as shown in photo-micrographs (Figs. 1 to 6).



Photo-micrographs showing different stages of meiosis in different cucurbit plants.

FIG. 1. I Metaphase, side view (*Momordica dioica*).
FIG. 2. II Metaphase, polar view (*Momordica dioica*).
FIG. 3. I Metaphase, polar view (*Momordica dioica*).
FIG. 4. I Anaphase, side view (*Momordica cochinchinensis*).

FIG. 5. Late diakinesis: Intervarietal hybrid in *L. acutangula* F₅ (monœcious, Richharia, 1952).

FIG. 6. Early I Anaphase, side view (Intervarietal hybrid in *L. acutangula* F₅ (Hermaphrodite, Richharia, 1952).

The procedure described below has been found to be particularly useful:

- (i) Fix anthers in 1:3 acetic alcohol for 2-3 hours.
- (ii) Transfer the material to 70 per cent. alcohol and then gradually pass it through alcohol series, 50 per cent., 30 per cent. to water, 5 to 10 minutes in each.
- (iii) Transfer the material in 4 per cent. iron alum solution for 10 to 15 minutes.
- (iv) Rinse it in tap water, in 50 per cent. alcohol, then 70 per cent.
- (v) Put the material in a drop of aceto-carmine on a slide.
- (vi) Put a cover slip over the anthers and crush the material by tapping it by the wooden end of the needle.
- (vii) Put it on a hot brass plate (60°-70° C.) for 5 to 10 minutes,

- (viii) Prevent drying up of the smear by putting fresh drops of 45 per cent. acetic acid at the end of the cover slip.

Agricultural Res. Inst., R. H. RICHHARIA
Botanical Section, P. N. GHOSH.
Sabour, Bihar,
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CYTOLOGICAL STUDY OF *SOLANUM MACRANTHUM* DUN.

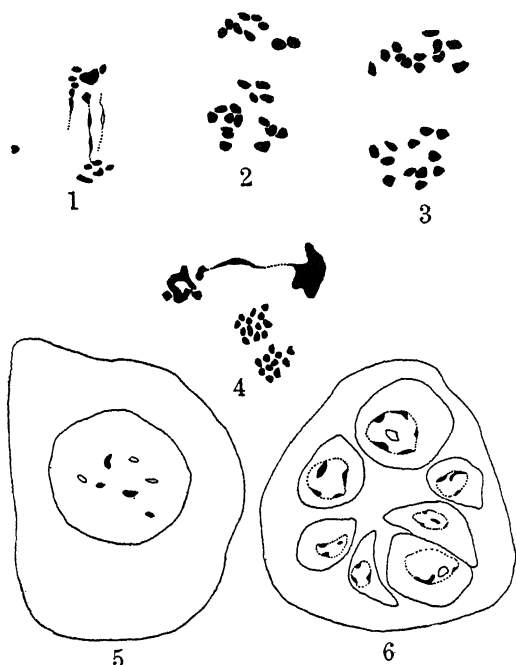
THE occurrence of three sterile tall trees of *Solanum macranthum* in Sabour (Bhagalpur) led to the present study. These trees were introduced here at Sabour ten years back. Trees are about 20' in height and 2' in girth. They flower throughout the whole year. Inflorescence is single or branched extra-axillary peduncled with 50 to 160 flowers per peduncle. The flower which is bluish-violet is much bigger than that of the cultivated brinjal; the diameter of the corolla is 2.5" to 3.5". This year in October 1952 only one fruit of 1.5" diameter was obtained from one of the ten-year-old trees. The seeds of the fruit are like that of the cultivated brinjal but they are bit bigger in size and the surface is rough.

According to Bailey¹ the native home of this species is Brazil. It has not so far been reported by the authors of the Indian floras.

Cytological studies of the genus *Solanum*² have shown 12 as the meiotic number of chromosomes in the genus with the exception of some polyploid forms, but the species with the chromosome number $n = 12$ are unreported as yet.

Examination of chromosomes at different stages showed 12 as the haploid chromosome number (Fig. 3). The orientation of bivalents at the metaphase is irregular; great irregularity was observed in the distribution of chromosomes on the two poles at anaphases (Figs. 2 & 4). Lagging of bivalents bridges and fragmentation was observed at anaphase I (Fig. 1) and that of univalents at the II anaphase (Fig. 4). The following types of numerical distribution of chromosomes were observed at anaphases: Anaphase I (12-12, 11-13, 10-14, 9-15); Anaphase II (12-12, 12-12; 11-11, 13-13; 10-10, 14, 14; 9-9, 15-15) respectively. 11-13 distribution was found to be more frequent than others at both the divisions (Fig. 4).

Smearing of anthers in acetocarmine showed that the pollen-mother-cells after completion of meiotic divisions form 2 to 7 cells (Fig. 6) in



each mother-cell. Monads were also seen (Fig. 5 and Table I, Col. 1).

TABLE I

Number of Cells per Pollen-Mother-Cells

| No. of Cells per P.M.C. | Frequency | Total No. of Daughter Cells |
|----------------------------|-----------|--------------------------------|
| 1 | 10 | 10 |
| 2 | 7 | 14 |
| 3 | 91 | 273 |
| 4 | 795 | 3180 |
| 5 | 219 | 1095 |
| 6 | 63 | 378 |
| 7 | 21 | 147 |
| Total .. | 1206 | 5097 |

Average number of cells per P.M.C. = 4.23 .

The above table shows that 4 is the more common number of cells per P.M.C. and the average number of cells per P.M.C. is 4.23 . The pollen grains are of various sizes (Fig. 6). Only 40 per cent. of the grains are stained by acetocarmine.

Selfing of the trees and reciprocal crosses with cultivated brinjal are being tried to induce fruiting. Pollen germination in agar agar and sugar media and in sugar solutions of various

strength were tried; only a few grains germinated in 20 per cent. sugar solution.

If fruiting can be induced in these sterile perennial trees it would prove to be of great economic importance. Further studies are in progress.

Our thanks are due to Dr. R. H. Richharia, Dr. G. I. Patel, Prof. A. B. Saran for helpful suggestions and to Dr. K. Biswas for identification of the material. We are grateful to Dr. S. Anwar Ullah for providing facilities to take up this study.

Bihar Agric. College, RAM PRAKASH.

Sabour (Bhagalpur), BISHWANATH CHATTERJEE.
Bihar,

December 22, 1952.

1. Bailey, L. H., *Standard Cyclopedia of Horticulture*, 1917, 6, 3181-86. 2. Darlington, C. D., and Janaki Ammal, *Chromosome Atlas of Cultivated Plants*, George Allen & Unwin Ltd., London, 1945.

GREEN MUSCARDINE FUNGUS ON PYRILLA SP.

THE occurrence of the fungus, *Metarrhizium anisopliae* (Metsch) Sorokin, on the insect pest, *Pyrilla* Sp. of sugarcane is known to the sugarcane growers in the factory area of South Arcot District in this State where it commonly occurs in varying degrees almost every season. When the sugarcane research scheme was initiated in this State, the utility of this fungus in biological control of *Pyrilla* Sp. was one of the subjects of study at Anakapalle where the occurrence of the fungus was noted in 1949.¹ Kamat and others² recorded the occurrence of this fungus in Bombay in 1952.

The fungus was isolated and cultured in oats-agar medium and sprayed on the insect pests. Parasitisation was satisfactory both under field and laboratory conditions, but success under field conditions was met with only when the humidity was high. It was also observed both on this research station and in the factory zone of South Arcot District that under natural field conditions, the peak period of the insect pest is from August to October while the peak parasitisation period was from September to January in which latter period the temperature was lower affording favourable conditions for the fungus to grow.

Investigations on this fungus since 1949 recorded in the annual reports of this station indicated that research in regard to the methods of establishing the fungus in the field irrespective of the climatic factors during the period of spray need thorough investigation. Without

detailed knowledge on this aspect, it may be difficult to utilize this fungus in the field for biological control of the insect pests on a commercial scale.

Sugarcane Res. Station, S. V. PARTHASARATHY.
Anakapalle, P. PRAKASAM.
January 27, 1953. C. S. KRISHNAMURTHY.

1. *Annual Report of the Sugarcane Research Scheme for Madras Province for 1949-50*, p. 52; 1950-51, p. 106; and 1951-52, p. 54. 2. Kamat *et al.*, *Curr. Sci.*, 1952, 21, No. 11, 317.

ISOLATION OF TRIMETHYLAMINE OXIDE IN SOME INDIAN MARINE FISHES*

ESTIMATION of trimethylamine in marine fishes and fishery products as an index of spoilage is being adopted widely.¹⁻⁶ Opinion is divided on the presence of trimethylamine oxide, the precursor of the amine, in fresh-water fishes, although its presence in salt-water fishes has been confirmed beyond doubt.⁷⁻⁹ Its presence has been confirmed in 18 marine fishes of the West Coast of Madras State.

The various steps followed in the isolation of the trimethylamine oxide as a picrate derivative are similar to those outlined by Norris and Benoit,¹⁰ using the muscle juice obtained either with common salt or trichloroacetic acid.

Table I below gives the fishes examined and the corresponding melting points of the picrate derivatives.

TABLE I

| Serial No. | Common name | Scientific name | Melting points of the picrate derivative °C |
|------------|----------------|-------------------------------------------|---------------------------------------------|
| 1 | Mackerel | <i>Rastrelliger kanagurta</i> (RUPPEL) | 199-201 |
| 2 | Oil Sardine | <i>Sardinella longiceps</i> (Cuv. & Val.) | 196-197 |
| 3 | Silver bellies | <i>Leiognathus hindus</i> | 197-198 |
| 4 | White Sardine | <i>Sardinella fimbriata</i> | 197-199 |
| 5 | " | <i>Chupea lile</i> | 199-201 |
| 6 | Horse mackerel | <i>Carax crumenophthalmus</i> | 197-198 |
| 7 | Seer fish | <i>Cybinus guttatus</i> | 197-198 |
| 8 | Perch | <i>Serranus diacanthus</i> | 196 |
| 9 | Jew fish | <i>Sciaenops coitor</i> | 200-201 |
| 10 | Soles | <i>Cynoglossus semifasciatus</i> | 198-200 |
| 11 | Cat fish | <i>Arius thalassinus</i> | 197-199 |
| 12 | Anchovy | <i>Engraulis mystax</i> | 197-198 |
| 13 | White Bait | <i>Stolephorus sp.</i> | 200 |
| 14 | Ribbon fish | <i>Trachurus savala</i> | 196-197 |
| 15 | Black pomfret | <i>Strimatus niger</i> | 199-201 |
| 16 | Shark | <i>Carcharias acutus</i> | 201-202 |
| 17 | Skate | <i>Rhinoptera sp.</i> | 199-202 |
| 18 | Prawn | <i>Metapenaeus sp.</i> | 196 |

All the above derivatives melted with decomposition and the melting point correspond to the picrate derivatives obtained from pure chemical sources in this laboratory (199-200° C.) and also in accordance with that given in the literature (196-202° C.). It is hoped that the estimation of the amine will be a handy tool in spoilage studies of these species of fishes.

Fisheries Tech. Station, R. VENKATARAMAN.
Kozhikode, S. T. CHARI.
January 5, 1953.

* Published with the kind permission of the Director of Fisheries, Madras.

1. Beatty, S. A., and Gibbons, N. E., *J. Fish. Res. Bd. Can.*, 1937, 3, 77. 2. Hansen, S. H., and Bekke, K., *Rep. Norwegian Fish. Res. Lab.*, 1947, 1 (6), 65. 3. Sigurdsson, G. J., *Ind. and Eng. Chem. (Anal. Ed.)*, 1947, 19, 892. 4. Ronald, O. A., and Jacobsen, F., *J. Soc. Chem. Ind.*, 1947, 66, 160. 5. Shewan, J. M., *J. Roy. Sanit. Inst.*, 1949, 69, 394. 6. Velankar, N. K., *J. Sci. and Ind. Res. (India)*, 1952, 11A, 359. 7. Baldwin, E., *Biochem. Soc. Sympos.*, 1951, 6, 3. 8. Shewan, J. M., *Ibid.*, 1951, 6, 28. 9. Dyer, W. J., *J. Fish. Res. Bd. Can.*, 1952, 8, 314. 10. Norris, E. R., and Benoit, G. J., *J. Biol. Chem.*, 1945, 153, 433.

ON A NEW LOCALITY RECORD OF THE LAND PLANARIAN *DOLICHOPLANA FEILDENI* (v. GRAFF)*

Dolichoplana feildeni (v. Graff) has so far been reported only from Java, Ceylon and Barbados.¹ The specimen referred to in this note, which has been identified as *D. feildeni*, was received from the Curator, Bombay Natural History Society, Bombay, for determination. It was collected by Mr. Salim Ali from Pali Hills, Bandra, Bombay State.

The specimen is of a muddy brown colour on the dorsal surface and slightly pale brown on its ventral aspect, with six dark stripes, of which the two lateral pairs are blue black in colour; whereas those reported from Java are yellow and of Ceylon dark brown. Six longitudinal stripes characterise this species; a pair of median thin lines approximating each other, and two pairs of thick lateral stripes, the innermost pair being the deepest of all. On the ventral side, the specimen is marked by a grayish ambulacral surface in the middle and two lateral brown stripes. In the preserved state the specimen is 8.8 mm. in length and 0.25 mm. in breadth. The size seems to be of a young individual as compared to the specimens reported upon by Whitehouse^{2,3} from Ceylon and Java. The occurrence of this species in India shows that it is not local in distribution, but has an

extensive range, both in the oriental and neotropical regions.

I am indebted to Dr. B. S. Chauhan, for confirming my identification and to Dr. S. L. Hora, for valuable suggestions.

Zoological Survey of India, G. RAMAKRISHNA,
Calcutta-12,
December 23, 1952.

* Published with the kind permission of the Director, Zoological Survey of India, Calcutta.

1. Graff, v., *Monographien der Turbellarien II Tricladida Terricola (Landplanarien)*, 1899, 2, 533, pl. 17, figs. 3-45. 2. Whitehouse, R. H., *Rec. Ind. Mus.*, 1919, 16, 32, figs. 17 and 18. 3. —, *Ibid.* 1912-22, 8, 455.

ARTICULATION OF PROPECTUS WITH HEAD IN *LESTODRYINUS PYRILLAE* KIEFF. (DRYINIDAE HYMENOPTERA)

WHILE studying the skeleto-muscular mechanism of *Lestodryinus pyrillae* Kieff., a new type of articulation was observed which had hitherto escaped the notice of earlier morphologists,^{1,2,3} who had held that the occipital processes [Fig. 1 (e)] were alone responsible for the articulation of head with propectus. A number of preparations of the head and thorax were made and all these beyond doubt do not show any

connection between the occipital processes and the occipital condyles. In *Lestodryinus*, the occipital processes are wide apart and oppose the posterior tentorial pits and do not take part in the articulation. The cervical apodeme [Fig. 1 (d)] which is a mesal expansion in the anterior region of the horizontal apodeme according to Snodgrass and the same which has been named by Duncan as "posterior ramus of the occipital process" is seen to be articulating with the occipital condyles present on the rim of the foramen magnum. It is seen from Fig. 1 that the occipital processes are diverging away from the foramen magnum and there is absolutely no possibility of any articulation with the occipital condyles. According to the above cited authors the movement of the head in those insects studied is restricted upward and downward only. However, it is felt that as the pointed cervical apodemes are articulating with the cup-like occipital condyles, undoubtedly this type of articulation facilitates the all-round movement of the head, which is most essential for a parasite of this family.

I am grateful to Dr. E. S. Narayanan, for his guidance and encouragement during the course of this work.

I.A.R.I., New Delhi,
September 9, 1952.

B. R. SUBBA RAO.

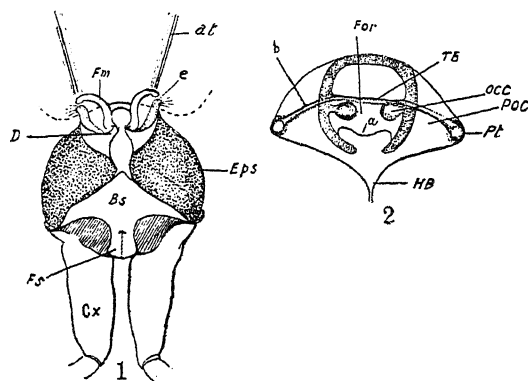
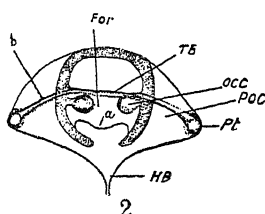


FIG. 1. Propectus with head attached pressed from dorsal side. *Fm*—Foramen magnum; *D*—Cervical apodeme; *e*—Occipital process; *at*—Anterior tentorial arm; *Eps*—Episternum; *Bs*—Basisternum; *Fs*—Furcasternum; *Cx*—Coxa.

FIG. 2. Foramen magnum seen from dorsal side. *a*—Shelf-like plate on lower margin of foramen magnum; *b*—Hollow bar from posterior tentorial pit; *pt*—Posterior tentorial pit; *TB*—Tentorial bridge; *Occ*—Occipital condyle; *Poc*—Post occiput; *HB*—Hypostomal bridge; *For*—Foramen magnum.



1. Snodgrass, R. E., *Smith Misc. Coll.*, 1942, 103 (2).
2. Duncan, C. D., *Stanford Univ. Pub. Biol. Ser.*, 8, (1), 272. 3. Alam, S. M., *Aligarh Muslim Univ. Publ. Zool. Ser. On Indian Insect Types*, III.

THREONINE IN BENGAL GRAM : A CORRECTION

DUE to an inadvertent omission of a factor of two, we find that the figures for the threonine content in Bengal gram reported earlier¹ have to be halved. Accordingly, the threonine content of Bengal gram based on the results of three assays give an average value of 4.05 g. per 100 g. of protein, with a range of 3.98-4.11 g. This change in figures does not alter our interpretation or the conclusions drawn from our results.

Nutrition Res. Lab., P. R. SRINIVASAN.
I.C.M.R., Coonoor, P. K. VIJAYARAGHAVAN.
March 2, 1953.

1. Srinivasan, P. R., and Vijayaraghavan, P. K., *Curr. Sci.*, 1952, 21, 102.

REVIEWS

Commercial A.C. Measurements. By G. W. Stubbings. 3rd Edition (Revised). (Chapman & Hall Ltd.), 1952. Pp. 377. Price 50 sh.

It is recognised that electrical measurements and measuring instruments play a very important part in electrical engineering. Mr. Stubbings's well-known book, first published in 1930, deals with the theory and practice of the measurement of current, voltage, power, energy and power factor in A.C. circuits and thus fills the gap between books containing descriptive work on the construction of electrical instruments and those dealing with electrical testing.

The first three chapters deal with A.C. theory in reference to its bearing on commercial A.C. measurements. The treatment includes discussion on distorted waveforms, harmonic analysis, symmetrical components, etc., in a simple way. Two chapters are devoted to the methods of measurement of current and voltage and of power. The principles of operation of different types of instruments for measurement of these quantities are discussed; the British standards requirements for such instruments are also discussed. A whole chapter has been allocated to instrument transformers and to methods of measuring their errors.

A chapter each has been devoted to the discussion of instruments for measurements of energy, reactive power, and kilovolt-amperes. Measurement of power factor and frequency and the determination of phase sequence are treated in one chapter. The materials in these chapters have been brought up to date in this edition. A new chapter on the measurement of maximum demand has been included. The concluding chapter deals in general with miscellaneous apparatus and provision needed in test rooms. Indications are also given in this chapter of a well-defined system for the recording of test results and the desirable method of calculation of test results. A short bibliography of reference to related literature is given in the appendix.

The author's works on Electricity Meters and Meter Testing, A.C. Protective Systems, and A.C. Measurements are well known. The present book, though written primarily for test engineers and for those intending to specialise in the subject of electrical measurements, will be very useful to engineers engaged on the technical side of the electrical industry.

C. S. GHOSH.

Rocket Propulsion. With an Introduction to the Idea of Interplanetary Travel. By Eric Burgess. (Chapman & Hall Ltd.), 1952. Pp. 235. Price 21 sh.

Here is a book which will serve as an admirable introduction to the subject of rocket propulsion for the laymen, besides also catering to the needs of students and specialists who might require a handy reference book on the subject.

The technical aspects of rocket propulsion are covered in broad outline in the course of the first five chapters under the headings: General Principles, Fuel, Rocket Motor, Problems of Fuel Feed and Fuel Tanks, and Control of Flight. Long-range rocket projectiles are dealt with in Chapter VI.

The succeeding two chapters are of such general interest and importance to the non-technical reader (forming nearly 95% of the world's population) that it should be eminently worthwhile to publish them separately under the subtitle: "Interplanetary Travel". There is a useful appendix giving the derivations of equations employed in rocket flight.

Polarography. Vol. II. (Second, completely Revised and Augmented Edition). By I. M. Kolthoff and James J. Lingane. (Interscience Publishers, New York and London). Price \$11.00.

This valuable book is a continuation of the previous one and consists of parts 3-6 spread over 34 chapters. Part 3 gives a systematic and up-to-date review of the fundamental facts about the polarography of elements. The last chapter in this part deals with the analytical details of alloys, ores and other technical products. Part 4 deals with organic polarography and consists of 12 chapters. The polarographic behaviour of unsaturated hydrocarbons, organic halogen compounds, carbonyl compounds, quinones, organic acids, nitro compounds, sulphur compounds, heterocyclic compounds containing oxygen and nitrogen are clearly and systematically treated. The information is particularly useful to research workers in organic polarography which is still not clearly understood. Part 5 deals with the biological applications of polarography. The use of the polarograph in serological cancer diagnosis dealt in this section is of particular interest. In Part 6, the authors

give an exhaustive account of amperometric titrations, where the authors have made substantial contributions using both the dropping mercury electrode and the platinum micro electrode. The advantages and disadvantages of the techniques are critically pointed out.

In this volume, the authors have taken meticulous care in cataloguing all the facts with reference to individual compounds. The treatment is highly exhaustive and critical. This second volume dealing as it does, with the practical application of polarography, is complementary to Volume I which is primarily concerned with fundamental theoretical aspects. This volume contains author and subject index. As with the first volume, the price of the book is too high.

It is a pity that tables containing half-wave potentials for inorganic ions in various media are omitted. Such tables with the data brought up to date would have facilitated easy and quick reference.

M. R. A.

Physical Chemistry Made Plain. By J. H. Mandelberg. (Cleaver-Hume Press Ltd., London), 1952. Price 15 sh.

The preface indicates that the book is of the post-Matriculation level and intended for those with a mathematical equipment below the average. But the scope of the volume covers the ground required for the Main Pass Degree in our Universities at present (!) in fifteen chapters. The treatment will be found useful by the average student who has not taken mathematics in the Intermediate. A welcome feature for the student is the brief theoretical introduction in each chapter and worked examples of different types. The volume is well produced, and the price moderate.

S. V. A.

Inorganic Chemistry—Introductory Lecture Notes. By Joseph Reilly. (Cork University Press, Oxford, B. H. Blackwell Ltd.) Price 8 sh. 6 d.

As Prof. Reilly observes, these lecture notes have been issued "for the convenience of students—not as a substitute for text-books, but to reduce the need for notes-taking and for use in revision". The lectures, about 70 in number, fully cover the syllabus set for the Intermediate of our Universities. Considering the excellence in get-up, printing, paper and illustrations, the price would seem to be very moderate. The volume should prove highly useful to our undergraduates.

Jute Substitute Fibres. By A. E. Haarer. (Published in 1952 by Wheatland Journals Ltd., London), Pp. xxii + 185. Price 30 sh.

Attempts to replace jute, the world's cheapest packing material, and practically a monopoly of India, were made before the last war in various ways, such as the use of elevators in bulk handling of commodities; paper and cotton bags, etc. But the idea of growing substitute fibres developed after the war, due largely to the scarcity of jute and its unusually high price. After partition, India also encouraged the cultivation of such fibres as jute was in short supply and mesta, etc., grows where jute does not thrive.

Of the numerous long fibres claimed as jute substitutes, only three, viz., mesta or Bimlipatam jute (*H. cannabinus*), Congo jute (*Urena lobata*) and Roselle (*H. subdariffa*), really count. These are the contents of this book; Chapters I-VII (77 pages) are devoted to mesta, the nearest approach to jute. All aspects of fibre production from seed sowing to fibre drying including mechanical cultivation and extraction have been described in detail. Chapters VIII to XI (33 pages) relate to roselle and the remaining five to *U. lobata*. The book contains an up-to-date review of the position these fibres occupy as jute substitutes and will be useful to all concerned with their production; chemical and physical aspects have, however, received scanty attention. The main difficulty is the costly labour (compared to India); unless every operation can be mechanised (which is not yet a reality) the chances of bulk production of such fibres at a competitive price seem rather remote.

P. B. SARKAR

Annual Review of Biochemical and Allied Research in India, Vol. XXII for 1951. (Published in 1952.) Price Rs. 3.

This annual review which has been published by the Society of Biological Chemists (India) gives an account of the research work carried out in India during 1951 in biochemistry and allied fields. The subjects reviewed are soils and fertilizers, plant products, vitamins, food technology, human nutrition, human pathology, dairy science, animal nutrition, and microbiology including antibiotics. The review on the whole is a commendable effort and gives an indication of the increasing tempo of research work carried out in biochemical and allied fields in India. But the subjects chosen for review are so extensive that the authors can attempt no more than catalogue various publications which

have appeared in the scientific literature during the year. Hence they lack the cogency as well as the critical appraisal, which are so essential for a proper understanding of the significant advances. One wonders whether a publication of this kind cannot be more useful if selected topics of a restricted nature are chosen every year, and the authors requested to write the reviews against the background of world literature. If need be, the papers published in India on Biochemical and Allied Research can be catalogued under appropriate heads and published as an appendix to such a review. A procedure of that nature will also eliminate the anomalous manner in which investigations carried out by Indian scientists in foreign laboratories are quoted in various sections of the present review. Proof-reading can also be made more exact, and errors such as are found in page 11, reference 37, and in page 56, line 18 may be avoided in future publications of this review. The volume as published should, however, prove invaluable as a source of reference for work carried out in India and deserves to be read by all interested in biochemical and allied research in India.

P. S. SARMA.

Books Received

- Astronomy for Everyman.* Edited by Martin Davidson. (J. M. Dent & Sons. Ltd.), 1953. Pp. xviii + 494. Price 18 sh. net.
- Practical Plant Pathology.* By M. N. Kamat. (Prakash Publishing House, Poona-2), 1953. Pp. xiii + 200. Price not given.
- The Radiant Universe.* By George W. Hill. (Philosophical Library, New York). Pp. xv + 489. Price \$4.75.
- Gravity Waves.* Edited by A. V. Astin. (United States Department of Commerce, National Bureau of Standards), 1952. Pp. iii + 287. Price \$1.75.
- Progress in Nuclear Physics*, Vol. 2. Edited by O. R. Frisch. (Pergamon Press Ltd.), 1953. Pp. viii + 294. Price £3-3-0.
- General Properties of Matter*, Part I. By C. J. Smith. (Edward Arnold & Co.), 1953. Pp. v + 580. Price 50 sh. net.
- The Cathode Ray Oscillograph in Industry*, 4th Edition. By W. Wilson. (Chapman & Hall Ltd.), 1953. Pp. xvi + 273. Price 36 sh. net.
- Challenge of the Unknown.* By Louis K. Ans-pacher. (George Allen & Unwin Ltd.), 1952. Pp. 351. Price 16 sh. net.

THE LATE SIR CHARLES SHERRINGTON

IN the course of his Presidential Address to the Royal Society, Prof. E. D. Adrian observed :

Few scientists of our time have been so well qualified to judge the advance of human understanding of the natural world as Sir Charles Sherrington, for he lived long enough to have witnessed most of the great achievements of the present era, and he had made an intimate study of the science of the Middle Ages, when the schoolmen and the alchemists were as satisfied with their theories as we are with ours.

But Sherrington was primarily a physiologist, and so was interested in the development of ideas concerning the living organism—"Man on His Nature". In his own work he had seen the transformation of physiology from a science still largely anatomical and concerned with the description of bodily adjustments into one which is more concerned with the cell and makes full use of the most advanced techniques of physics and chemistry. His work reflected this change in that his earlier experiments dealt with reflex movements and his later with the control of the individual motor units; but its enduring quality comes from the fact that he was always alive to the whole range of biological

inquiry. He thought of cell activities in their relation to the organized behaviour of the whole animal.

He studied the integrative action of the nervous system. That was the title of his classical series of lectures published in 1906. His method was to select a relatively simple movement which could be evoked under standardized conditions, like the withdrawal of the foot from a noxious stimulus, to study the whole apparatus of sense organs, nerve fibres and central cell stations concerned in such a reflex and by doing so, to establish the general principles by which simple movements are compounded to give more elaborate activity.

His book was reprinted by the Physiological Society when the International Congress met in Oxford in 1947. It needed no alteration, and although a great deal had been found out about the nervous system since 1906, the general conclusions are still the only general conclusions which can be drawn. But this is not so much a confession of the failure of neurologists to solve their problems as an index of the fundamental difficulty, at all events the fundamental nature, of the main problem, which is to construct a physiological picture of intelligent behaviour.

SCIENCE NOTES AND NEWS

Control of Fennel Thrips -*Hercothrips indicus*

Shri H. L. Kulkarny and R. C. Patel, Entomological Laboratory, Institute of Agriculture, Anand, write as follows: During 1952, the fennel crop in North Gujarat suffered very heavily due to the attack of thrips, *Hercothrips indicus*. Within 11 days the population of thrips per unit length examined rose from 2.4 to 97.6. Out of the various insecticides tried for the control of thrips, 0.2 per cent. D.D.T. water suspension spray with nicotine sulphate diluted as per standard formulations gave reduction in the population of thrips by 97.0 per cent. at the end of two weeks. Nicotine sulphate when sprayed alone gave 87.1 per cent. kill but then, reinfestation by the pest was noticed after a lapse of six days. In case of D.D.T. nicotine treatments, the fennel crop was at a very low level of infestation -5.2 insects per unit length examined. BHC water suspension sprays at 0.2 per cent. concentration gave similar results as in nicotine compound alone. Only one good spray of D.D.T.-nicotine sulphate, was sufficient to control the pest. The authors are grateful to Dr. G. A. Patel for the identification of insects.

A Natural Chimera in Groundnut (*Arachis hypogaea* L.)

Sri. O. P. Tyagi of the Botany Section, Government Agricultural College, Kanpur, writes as follows:

A chimeral plant of groundnut was observed having all its branches normally green except two, one of which was half-green and half non-green or white and the other one having light green tinge all over. The upper leaves borne by the former branch were all pure white throughout and the two lower-most ones had three kinds of leaflets, viz., (1) normal green, (2) half-green and half-white, and (3) pure white. The leaves borne by the latter one were all pure white.

Need for Indian Medical Abstracts

Shri. S. G. Chandavarkar, Librarian, Osmania Medical College, Afzal Gunj, Hyderabad-Deccan, suggests that medical associations in India should take active steps to compile and bring out an index (or abstracts) of articles published in Indian Medical Journals on lines similar to those of the *Quarterly Cumulative*

Index Medicus (American Medical Association) or the *Abstracts of World Medicine* (British Medical Association). Such a compilation will be of immense help to research workers both in India and abroad.

Plant Protection Bulletin

The Food and Agricultural Organization of the United Nations has begun publication of the monthly *Plant Protection Bulletin*, devoted to the global problem of combating plant diseases and pests. An important feature of the Bulletin will be plant quarantine announcements: this is the first time that such information is made available on a world-wide scale.

European Nuclear Research Laboratory

A site near Geneva, Switzerland, has been selected for the Nuclear Research Laboratory. The laboratory which will take about seven years to build and equip, will house the world's most powerful cosmotron rated at 30,000 million electron volts. There will also be a synchrocyclotron with a rating of 600 million electron volts. The laboratory is meant exclusively for pure research, the results of which will be supplied freely to all member nations of the European Council for Atomic Research, an organization founded recently with the help of UNESCO.

Nicotine Sulphate from Tobacco Wastes

A simple process has been developed at the National Chemical Laboratory, Poona, which renders recovery of nicotine sulphate from Indian tobacco wastes an economic proposition. The process (covered by Indian Patent Nos. 45666 and 46994) consists of pulverising tobacco waste, mixing it with lime and extraction of the mixture with a solution of common salt. The resultant broth is suitably stabilised and extracted with kerosene in a specially designed column. Nicotine is recovered from the kerosene solution by fixing it with dilute sulphuric acid. The kerosene can be recycled without any further treatment. An overall recovery of 93 per cent. is obtained. The process has been successfully tried both on a laboratory scale and pilot plant scale. The equipment required is simple and can be easily assembled. Further details can be had from the Industrial Economist, Council of Scientific and Industrial Research, New Delhi.

Point-contact Transistors

The Philips Factories in Holland have announced two types of point-contact transistors, OC 50 and OC 51. The OC 50 is intended for general amplifying purposes. The OC 51 is meant for switching applications. These transistors have the shape of small cartridges of about $\frac{1}{2}$ " length and $\frac{1}{4}$ " in diameter, with two wires leading out at one side. The metal casing serves as the third electrode. We understand that samples of these transistors will be available shortly in this country.

Box Cultivation of Vegetables

The highly useful method of box cultivation of vegetables has been described in the January-February 1951 issue of *Indian Farming*.

With proper care it may be of much help in the self-sufficiency drive in respect of food. The advantage of this method is that the boxes can be easily moved and vegetables can be grown on open roofs and verandahs of buildings.

The Indian Science Congress, 1954

The following Office-bearers were elected for the next session of the Indian Science Congress to be held at Hyderabad: *President*: Dr. S. L. Hora; *General Secretaries*: Dr. S. R. Sen Gupta and Dr. B. N. Prasad; *Treasurer*: Prof. P. C. Mahalanobis.

The following have been elected as Presidents of the various sections: *Mathematics*: Dr. S. K. Chakravarty (Calcutta); *Statistics*: Dr. K. R. Nair (Dehra Dun); *Physics*: Dr. P. S. Gill (Aligarh); *Chemistry*: Dr. V. Subrahmanyam (Mysore); *Geology and Geography*: Dr. H. L. Chhibber (Benaras); *Botany*: Dr. S. N. Das Gupta (Lucknow); *Zoology and Entomology*: Dr. D. V. Bal (Delhi); *Anthropology and Archaeology*: Shri. Dharani Dhar Sen (Lucknow); *Medical and Veterinary Sciences*: Dr. R. N. Chowdhury (Calcutta); *Agricultural*

Sciences: Dr. B. P. Pal (New Delhi); *Physiology*: Dr. P. B. Sen (Calcutta); *Psychology and Educational Sciences*: Dr. Surhid Sinha (Calcutta); *Engineering and Metallurgy*: Shri. H. N. Srivastava (Jubbulpore).

Dr. S. Husain Zaheer

Dr. S. Husain Zaheer, Director, Central Laboratories for Scientific and Industrial Research, Hyderabad, and Head of the Department of Chemical Technology, Osmania University, will be proceeding to Europe and U.S.A. on a United Nations Economic Development Senior Fellowship. While abroad, he will study various industries, especially coal, ceramics, oils and fine chemicals, their relation with research laboratories, the developmental projects and method of passing completed processes for large-scale manufacture.

Symposium on Chromatography

Under the auspices of the Society of Biological Chemists, India, a Symposium on Chromatography will be held on the 3rd and 4th April 1953 in the Power Engineering Department of the Indian Institute of Science, Bangalore.

Award of Research Degree

The Andhra University has awarded the Degree of Doctor of Science in Physics to Mr. Bh. Krishnamurti for his thesis entitled "Ultrasonic Studies in Electrolytes and Liquid Mixtures", and to Mr. V. G. Krishnamurti for his thesis entitled "Structure of the Band Spectra of the Halides of Cobalt and Nickel".

ERRATUM

Vol. 22, No. 2, p. 50: Note on "Further Evidence from Fish Distribution of the Rise in Salinity of the River Hooghly": Reference 2 should read as follows: (2) Pillay, T. V. R., *Curr. Sci.*, 1953, 22, 82.

NOTICE

All material intended for publication in *Current Science*, corrected proofs, books for review and exchange journals, may please be sent to the Editor:

Professor G. N. Ramachandran,
A. C. College of Technology,
Madras-25.

Remittances, correspondence regarding subscriptions to the journal, advertisements and requests for missing numbers, etc., may please be addressed to:

The Manager,
Current Science Association,
Malleswaram P.O., Bangalore-3.

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FISH DISTRIBUTION AND CENTRAL ASIAN OROGRAPHY

IT has been maintained^{1,2} that the Yangtze Kiang basin was upraised 6,000' to 10,000' in very recent geological times, similar opinions being advanced by Deprat (not consulted) for Tongking and Eastern Yunnan. These conclusions were supported by lack of any evidence of glaciation, and of canyon formation by the rivers of Yunnan and Western China; but Gregory and Gregory³ considered these reasons inadequate "for so great an uplift at so recent a date". In their opinion, "Any change in rivers by which their currents become swifter and their fall steeper enables them to wear away their beds. This change may be produced on a high plain by the subsidence of the surrounding country or of deep internal basins." There-

fore, "The evidence of the glaciers of Chinese Tibet is rather in favour of a subsidence of the area than of its uplift."

Dr. M. S. Krishnan, Director, Geological Survey of India, from whom I have had much friendly help, favours the possibility of quaternary uplift. "The Middle or Upper Miocene", he informs me, "is thought to be the period of the greatest comprehensive movements, but this actual uplift due to isostatic compensation in the crust took place during the Pliocene or even later. While it is possible that the last uplifts of Central Asia took place in the Pleistocene, we cannot be sure whether a larger part of the elevation was not attained during the Pliocene". He added that as "Parts of Yunnan

and S.-W. China were in a tertiary orogenic belt, there is no reason why the uplift could not be as late as the Pleistocene or Sub-Recent."

There seems to be no way of resolving this controversy without further evidence, which I believe, can be found to a large extent in relevant zoogeographical studies. An analysis of the distribution of the fresh-water fishes of South-East Asia is accordingly presented here as a contribution to this problem. It supports the theory of recent uplift in the regions considered.

GEOGRAPHY OF THE FISH-FAUNA OF SOUTH-EAST ASIA

The distribution of the fresh-water fishes of South-East Asia⁴ suggests that the centre of dispersal of this remarkable fauna can be traced to south-west China, particularly Yunnan. It is so rich and highly diversified that there must have been favourable ecological conditions for it to flourish and speciate. Moreover, as this fauna now extends to Africa in the west, to Ceylon and the Malay Archipelago in the south, to Formosa and the Philippine Islands in the east, and to the Tien Shan Mountains and the Central Asiatic Highlands on the north, the questions of its age and periods of dispersal are of considerable general interest.

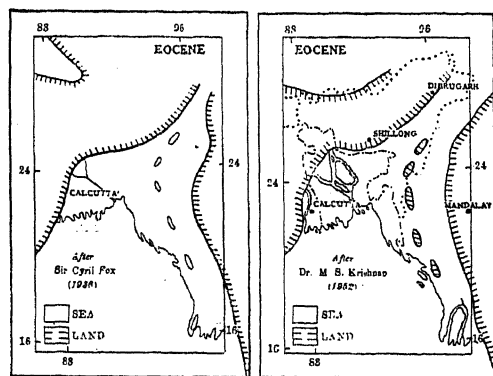


FIG. 1. The Bay of Bengal during Eocene Times

Geographically, it can be divided broadly into two groups: the trans-Himalayan fauna and the cis-Himalayan fauna. Day,⁵ Stewart,⁶ and Hora⁷ have shown that there is no noteworthy similarity between the fish-faunas of the northern and southern faces of the Himalayas: a few forms characteristic of the Asian Highland are found to the south of the Himalayas, but none of the typical southern forms is found in the trans-Himalayan areas of the region. Of course, according to our present taxonomic knowledge, allied or identical genera are found in both the

regions, but they look very different from one another and need more critical evaluation.

TERTIARY BARRIERS TO DISPERSAL

Geologists tell us that during the Eocene and Miocene periods there was an arm of the sea separating India from Burma (Figs. 1, 2),

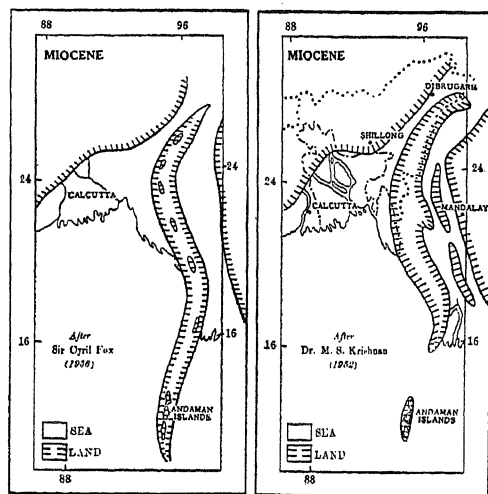


FIG. 2. The Bay of Bengal during Miocene Times

though Dr. M. S. Krishnan informs me that there is no evidence that "the Mist Hills region (E and NE of Sadiya) was under the sea at all in the Upper Tertiary, even if we take it that the Tethys extended over it and into Burma up to the end of the Eocene". Even so, the dispersal of fresh-water fishes from Yunnan to India could not have been possible during these periods, and there is no contrary palaeontological evidence.

The climate during these periods was probably temperate and equable, for the hot and moist winds from the south could then blow through the gap and over the northern regions. Dr. S. K. Banerji (former Director-General of Observatories, India), supports this view. After analysing the geological evidence, he informed me that: "Our present arctic regions were, during Eocene times, in about Lat. 45° N., and the lower part of the Archiboreis (Asiatic Block) was on the equator. The low pressure system during summer was apparently in the central part of this block, which caused an air-drift from the Thetis, as well as from the Pacific Ocean. At this time Yunnan was much nearer the equator than it is at present. The statement that hot and moist winds from the Tethys rendered the climate temperate and equable thus appears to be reasonably correct."

The effects of such a climate need little comment. In general they are conducive to the maintenance and gradual spread of animal species, but they do not enlarge the biological conditions and pressures that provoke migrations. This is especially true of fresh-water fishes.

THE BEGINNINGS OF DISPERSAL

In the Pliocene the picture changes (Fig. 3). The major upheaval of the Himalayas, which

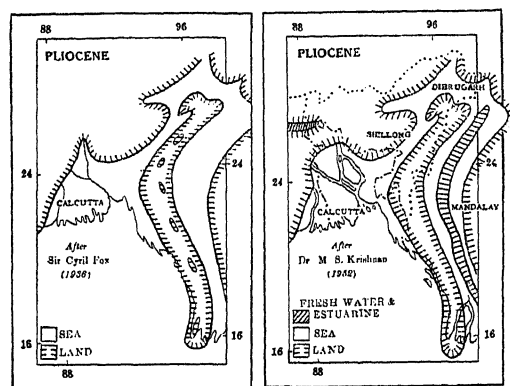


FIG. 3. The Bay of Bengal during Pliocene Times

seems to have occurred towards the close of the Miocene, or early in the Pliocene, probably rendered the arm of the sea shallow and may have cut it up into brackish water lakes and lagoons. With the advance of time, and concomitant with the Himalayan uplift movements, marshy conditions corresponding to those of the Siwaliks seem to have been established in this area.

Marsh-loving and sluggish-water fishes could now migrate to India. We know definitely that they did so from the occurrence of Bagrid fishes of the genera *Chrysichthys*, *Mystus* and *Rita*, Clariids⁸ of the genera *Clarias* and *Heterobranchius*, and various *Ophicephalids*, in the Siwalik rocks of India.

Low hills also made their appearance in the Pliocene. This is indicated by the occurrence of *Bagarius*, a characteristic hill-stream catfish of the family Sisoridae, in the Siwalik formations. It is found in south-west China, and is clearly a migrant from the Malayan region, where it is known from the tertiary deposits of the highlands of Padang in Sumatra.

The Pliocene climate of the Central Asian region, particularly south-west China, remained temperate and equable, while the area it affected was flat and fairly low. This can be inferred from the topography of the area between south-

west China and India (Fig. 3) at that time, as well as the ecological requirements of the fishes that then migrated to India: in fact, the nature of these fishes suggests that the climatic and topographical conditions of the period were somewhat similar to those now prevailing in Bengal.

It follows that the totality of the influencing Pliocene circumstances produced new environmental dynamics favourable to the migration of many species, but the westwards dispersal of the remarkably adapted torrential fishes is a much later phenomenon.

PLEISTOCENE CONDITIONS AND FISH DISPERSAL

There is abundant geological evidence that there was another major uplift of the Himalayas after the Pliocene. Therefore, the closing of the marine, estuarine and marshy gap between India and the countries to the east and north must have taken place during the Pleistocene.

The effect of this upheaval on the monsoons, which have an evident bearing on the ecology of fresh-water fishes, also concerns our argument. For the monsoons, as we know them in India to-day, could not have been established till their passage to the Central Asiatic region had been blocked by a mountainous barrier in the north-east; and Central Asia would accordingly have remained wetter and more favourable to fish-life than it is now.

Meteorological confirmation of this point again comes from Dr. S. K. Banerji, who writes (*in litt.*) that "The south-west monsoon in its present form apparently commenced to be established at the close of the Würm glaciation, that is about 20,000 years ago. But the temperature conditions that prevailed 10,000 years ago, as deduced from Milancovitch's curves, would strongly support your argument about the comparatively recent dispersal of fishes along the Western Himalayas". He also stated that the present monsoon system must have developed when the Himalayas attained a height of 10,000' to 15,000', which is roughly the depth of the south-west monsoon current.

Moreover, during the Pleistocene, there was periodic refrigeration and five periods of glaciation,⁹ each one of which lasted several thousand years. In the Western Himalayas (Kangra Valley), according to Wadia,¹⁰ the glaciers seem to have descended below 3,000'. In the Eastern Himalayas (Sikkim and Naga Hills), Blanford¹¹ recorded moraines, on the evidence of W. T. Blanford and H. H. Godwin-Austen, from elevations of 6,000' and 4,500'.

Consequently, the fish-fauna, if any, of the southern slopes of the Himalayas must have

been exterminated at higher altitudes during the glacial periods. Only a few forms, which have been either introduced or have means of migration, are now found at higher elevations, though fishes are found in some abundance and variety at lower elevations. The lakes and rivers of Central Asia, on the other hand, support a uniform but fairly rich fish-fauna, which seems to have escaped all the periods of Pleistocene glaciation or intense refrigeration. Their survival strengthens the view that the Central Asian region was at a quite low level even during the last glacial phase, and that its uplift took place during the last 10,000 to 15,000 years. The Central Asian fish-fauna is thus an antecedent fauna so far as the recent uplift is concerned.

THE EVIDENCE OF THE SCHIZOTHORACINE FISHES

This assumption gains from the fact that the remains of typical Central Asiatic Schizothoracine fishes have been found in the Karewas of Kashmir.¹² According to de Terra,¹³ the remains of the Schizothoracine fishes came from an exposure of Lower Karewa beds of the first interglacial period (approximately 560,000 to 500,000 years ago), which indicates the differentiation of the Central Asian fish-fauna about the middle of the Pleistocene. It should be noted, too, that the Karewa fossils were laid down in the bed of a lake or sluggish river at a much lower elevation; and were, as Sahní¹⁴ writes, "lifted out of their original horizontal position and upheaved through at least 5,000' with the (geologically speaking) recent upheaval of the Pir Panjal Range".

The first glacial period, through eustatic changes in the sea-level,¹⁵ seems to have produced a false uplift of a few hundred feet, thereby increasing torrential conditions in the streams of the young Himalayas and the adjoining regions. During this period, the Schizothoracine fishes seem not only to have spread along the northern face of the Himalayas, but a representative of the primitive stock also crossed the flat strip between the Garo and Rajmahal Hills, which we call the Garo-Rajmahal Gap. It came down the Western Ghats to the Periyar Lake of Travancore, where it developed, through isolation, into a new genus recognisably descended from its *Schizothorax*-like ancestor. Sundara Raj¹⁶ gave the fish providing this remarkable case of discontinuous distribution the name *Lepidopygopsis typus*; and pointed out that it occupies an intermediate position between the primitive and nearly related genera *Paratylognathus*¹⁷ and *Schizo-*

thorax, and such specialised genera as *Schizopygopsis* and *Gymnocypris*.

The differentiation of *Lepidopygopsis* can be simply explained. The primitive Schizothoracine stock that migrated to Peninsular India during the first glacial period had ample time to diverge from the stock that remained in Central Asia, particularly since the streams of the Peninsula were rejuvenated during the Pleistocene owing to a west-to-east tilt not amounting to actual uplift.¹⁸

CONCLUSIONS AND IMPLICATIONS

From the above evidence it would appear that in bulk the modern Ostariophysi (carps and catfishes) made their appearance in India in the Pliocene,* when the marine gap between India and south-west China had become a marshy area. *Bagarius*, a fish normally living in the deeper waters of rapids and cascades, also appeared about the same time; but the Schizothoracine came later and did not become widely distributed until the first glacial period of the Pleistocene. Fishes characteristic of the smaller torrential streams have a more or less parallel history of emergence in the early Pleistocene and wide distribution during its first glacial period, their present occurrence at lower elevations throughout their range being suggestive of their evolution in, and dispersal through, streams at lower altitudes. Radial dispersal of this remarkable fauna from Yunnan strongly favours the theory that this area was uplifted in geologically recent times.

The acceptance of this view involves some interesting general implications. For example, it would place the migration of the supposedly Aryan pre-historic peoples inhabiting the plateau of Central Asia somewhere between 7,500 and 10,000 years ago, because the last glaciation, which commenced about 18,000 years before the beginning of the Christian era, seems to have lasted for nearly 10,000 years. The Central Asian region must have been at a low level during this last glacial period, thereby permitting the survival of its fish-fauna and human populations.

Finally, the major evolutionary thesis prompted by the orographic history of the regions considered is that the relatively recent uplifts pro-

* I have recorded, *Rec. Geol. Surv. India*, 1938, **73**, 267-94, an incomplete Cyprinid scale from the Inter-Trappean beds of Deothan and Kheri, but was not able to assign to it any generic position. It is probable that early in the Eocene Cyprinoid fishes entered India through the then existing Cretaceous land bridge between India and China.

vided a dynamic environment conducive to migration, isolation and rapid speciation. The rich and very diverse fauna and flora of south-east Asia becomes more understandable in the light of this theory. Particular studies have accordingly been designed, with encouraging results, to prove its validity; but their discussion belongs to another and later synthesis.

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Calcutta.

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PREDICTION OF ELECTRONIC FAILURES

A RELATIVELY unexplored approach to the problem of insuring higher reliability of electronic equipment is being investigated at the National Bureau of Standards, U.S.A. A technique has been evolved experimentally in which a maintenance man simply plugs a portable failure-prediction unit into the slightly modified equipment to be checked and turns a multi-point selector switch; a red light flashes on to identify stages or components that have deteriorated below safe levels and have become prospective causes of equipment failure.

Failure of electronic equipment to function properly may be caused either by sudden or by

gradual failure of a tube or other component. Although improvement of quality seems to be the only way to reduce sudden failures of components, surveys have indicated that at least half of all equipment failures are produced by gradual deterioration of components. The NBS work has been concerned with practical means of spotting these gradual failures before the equipment becomes inoperative. The success of the experimental work at NBS suggests that provision for simple failure-prediction routines for the maintenance of important electronic equipment deserves the serious attention of design engineers.

COBALT 60 TO REPLACE RADIUM FOR CANCER THERAPY

A COBALT 60-beam therapy unit, a gift to Britain from Canada, is shortly to be installed at Mount Vernon Hospital, Northwood, Middlesex. The unit is described as being 200 times more powerful than the radium units in use at present. It is more stable, more reliable and simpler to control than super-voltage X-ray machines and might prove more effective in the control of cancer. It is expected to treat deep-seated, internal, inaccessible tumours which so far have proved beyond the effective range of existing apparatus. A further advantage of the unit is that a greater quantity of radiation could be delivered to the tumour with less damage to the surrounding normal tissues and less disturbance to the general state of the patient.

Cobalt 60 is produced by the exposure of natural cobalt in the nuclear reactor or atomic pile. It is particularly suitable as a substitute for radium in some methods of application. The cobalt itself is relatively cheap and readily obtainable. The cobalt 60 source in the units is a disk only 1" in diameter and ½" thick. The beam of radiation could be compared in penetrative power to that produced by an X-ray machine working at three million volts. The cobalt 60 deteriorates to half its original intensity in just over five years, and it is, therefore, necessary to arrange for reactivation in a nuclear reactor at regular intervals. The cost of a radium unit of such activity would be well over one million pounds, as compared with a cost of £ 25,000 of the cobalt unit.

at latitude $7^{\circ} 20' N.$ and longitude $84^{\circ} 48' E.$ on a south-south-east course, she reported wind W by N, 50 knots, gusting to hurricane force all night, with continuous heavy rain, visibility nil, heavy sea with west-north-westerly heavy swell and mean height of waves 25' to 30'. Barometric pressure was 1006.8 mb. and had been falling steadily in the previous 3 hours. The ship was labouring heavily with a maximum roll of 33° . The Captain of the ship who was interviewed later at Madras stated that extremely rough weather with mountainous seas was experienced on the night of the 28th-29th from 9 p.m. to 6 a.m. as the ship was sailing on a south-south-east course to avoid the cyclone. The ship had a miraculous escape with only a slight damage.

S. S. *Clan Mactavish*, which left Madras on the 29th evening for Colombo, was hardly 50 miles to the north of the storm centre when she reported at 0400 G.M.T. of 30th at latitude $11^{\circ} 16' N.$, longitude $80^{\circ} 54' E.$, easterly wind, force 11 (about 70 m.p.h.), high sea and swell and barometric pressure 993.8 mb.

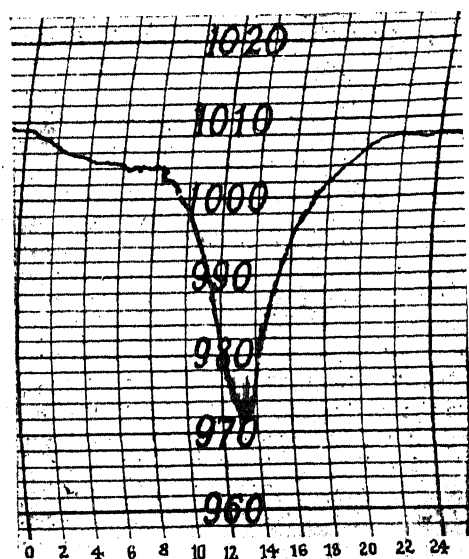


FIG. 2. Barogram of Nagapattinam, 30th Nov. 1952.

WEATHER AT NAGAPATTINAM

The weather at Nagapattinam was overcast with low clouds and raining from the midnight of the 29th and 2" of rain occurred up to 0730 a.m. of 30th. The wind was N. to NE. By 10 a.m. the wind increased to force 6-7 (30 m.p.h.) still from north to north-east and sky was overcast with driving rain. Sea when visible was very confused with mountainous waves. By 11 a.m. wind was gale force 9

(50 m.p.h.) and from then onwards it increased to hurricane force, still from the north-east. At about 1 p.m. it veered to east and according to the report of the local Port Officer the storm was at its climax at about 1-30 p.m. when the port was struck by a storm wave of great force which was estimated to be about 4' in height. The storm wave caused much damage in and around the port. At about 2-30 p.m., the wind veered to south-east and continued to blow with hurricane force until about 4-30 p.m. when it showed signs of abating. By 1800 hours the wind had become moderate and the sky had cleared considerably. Nagapattinam Observatory measured a wind speed of 50 m.p.h. at 1130 hours on the 30th after which the wind instrument got damaged.

BAROGRAM OF NAGAPATTINAM

The barogram of Nagapattinam Observatory reproduced in Fig. 2 reveals some very interesting features about the cyclone. The lowest pressure reached was about 970 mb. at about 1-30 p.m. on the 30th. This was about 40 mb. below the pressure 24 hours earlier which was about the normal pressure. The pressure began falling rapidly from 10 a.m. and fell by 29 mb. from 999 to 970 mb. in about 3 hours' time. The most rapid fall of pressure was 14 mb. from 11-30 a.m. to 12-40 p.m., a period of 1 hour and 10 minutes, which works out to a rate of fall of 12 mb. per hour. With the estimated speed of movement of the cyclone, viz., 12 m.p.h., the steepest pressure gradient in the inner area of the cyclone, as it passed Nagapattinam, works out to 1 millibar per mile. This was at a distance of about 20 miles from the centre. The gradient of 1 mb. per mile agrees with the average pressure gradient in typhoons with minimum pressure of 960 to 973 mb. given by Deppermann.¹ The steepest rate of pressure fall on record at the centre of an Indian cyclone was 25 mb. per hour in the False Point cyclone² of 5th November 1891 which had the lowest pressure of 949 mb. With a speed of movement of 10 m.p.h., the steepest pressure gradient in that cyclone works out to 2.5 mb. per mile, while in the present Nagapattinam cyclone it is estimated to be 1 mb. per mile at a distance of 20 miles from the centre and about 10 miles from the periphery of the "Eye".

Another interesting feature shown by the Nagapattinam barogram is the rapid fluctuation of pressure at the time of minimum pressure exhibiting pronounced "pumping" over the central region of the cyclone. The maximum amplitude of the fluctuations was as large as 7 mb., the pressure fluctuating between 970 and 977 mb.

THE EYE OF THE CYCLONE

The Nagapattinam cyclone had a pronounced Eye or calm centre as should be expected in a cyclone with such steep pressure gradient. In this connection, a summary of weather at Point Calimere reported by the Keeper-in-Charge of the Light House there is given below:—

"On the whole day of the 29th November, the sky was almost clear with some passing clouds. There was no rain. The wind direction was NE. Towards midnight the sky began to overcast with heavy clouds and very chilly NW wind. This continued until 7 a.m. of 30th with intermittent drizzling. After that, the force of the wind and rainfall increased gradually. At 9 a.m. the wind from the same direction increased to gale force mingled with moderate rain. This lasted up to 1 p.m. After that, the wind and rain suddenly stopped; sky began to clear with bright sunshine. The air was *dead calm*. Suddenly at about 1-45 p.m. some rumbling noise resembling distant approaching train was heard from south with whitish high waves in the sea. At 1-45 p.m. the wind at a force of about 75 to 80 miles an hour struck the coast from the south. The trees and roofs of the building began to fall down on the first impact itself. This lasted up to 4 p.m. and then onwards the force of wind decreased gradually. During the period of the cyclone there was very little rain in our part and should, in my estimate, be under 2" on the whole."

Mr. S. Gasper of the Regional Meteorological Centre, Madras, who visited the cyclone-affected areas, gathered information of similar experience of "Calm" conditions for sometime in the midst of the cyclone at Tiruthuraipundi, about 20 miles to the south-south-west of Nagapattinam and 22 miles to the north-west of Point Calimere, and also at Vedaranyam, about 6 miles to the north of Point Calimere. The Tahsildar at Tiruthuraipundi had recorded that heavy rains and northerly gales commenced at 0900 I.S.T. on the 30th and continued uninterrupted till 1415 hours. Thereafter, there was sudden cessation of rain and wind but the sky remained overcast. After about an hour of calm condition, hurricane winds recommenced from the opposite direction with heavy rain. At Vedaranyam, the Deputy Tahsildar had recorded similar observation with the difference that the lull in weather commenced at 1300 hours and lasted for about 45 minutes. Nagapattinam did not experience any calm condition or reversal

of wind direction. The Eye did not, therefore, pass through Nagapattinam.

The calm condition commenced at 1300 hours at Point Calimere and Vedaranyam and at 1415 hours at Tiruthuraipundi. Considering that the cyclone moved due west across the coast and that Tiruthuraipundi is about 15 miles due west of the coast, the approximate speed of movement of the cyclone works out to be 12 m.p.h., agreeing with the speed estimated from the positions of the cyclone centre as located on the synoptic weather charts. As the duration of the calm over Point Calimere was about 45 minutes, it means that a chord of about 9 miles of the "Eye" passed over that station. Similarly, a 12-mile chord passed over Tiruthuraipundi. On this basis, the position of the "Eye" at the time of the cyclone centre crossing the coast is indicated in Fig. 3. Assuming the Eye to be circular, its diameter works out to be about 20 miles. Even though the average diameter of the "Eye" of tropical cyclones is believed to be 10-15 miles, "Eyes" having diameters of 20-30 miles have also been observed in intense storms. A diameter of 40 miles has been recently reported³ from actual aircraft exploration of the "Eye" of a severe typhoon in the China Seas in August 1951 with a central pressure of 895 mb. A severe cyclone at the head of the Bay of Bengal on the 27th May 1936 had an "Eye" of about 20 miles diameter with a central pressure of 979 mb. The estimated diameter of the "Eye" of the recent Nagapattinam cyclone is, therefore, consistent with its severity as indicated by the steep pressure gradient and a central pressure of 970 mb. It is interesting to note that the "Eye" of the cyclone became obliterated in a short distance after crossing the coast as it was not felt at Pattukottai, about 35 miles west of the point where the centre crossed the coast. The cyclone moved as a deep depression whose centre passed about 25 miles south of Tiruchirapalli. The micro-barogram of Tiruchirapalli (not reproduced here) showed a fall of pressure of 18 mb. between 10-30 a.m. and 7-30 p.m., the fall being steepest between 5-30 p.m. and 7-30 p.m. The lowest pressure recorded at Tiruchirapalli was 979 mb. at 7-30 p.m.

WINDS IN THE CYCLONE

The cyclone was a very severe and concentrated one with a comparatively small core of hurricane winds around the calm centre ("Eye"). Nagapattinam had hurricane winds for about 5½ hours from 11 a.m. to 4-30 p.m. Assuming that the core of hurricane winds was circular

and the speed of movement of the cyclone was 12 m.p.h. when it struck the coast, a chord 66 miles ($12 \times 5\frac{1}{2}$) long of the inner core must have passed through Nagapattinam. From this, it is estimated that the radius of the core of hurricane winds was about 38 miles. As the radius of the "Eye" was about 10 miles, the annulus of hurricane winds around the "Eye" was about 30 miles wide. The diameter of the core of hurricane winds including the "Eye" was therefore about 80 miles. The extent of the core is also shown in Fig. 3.

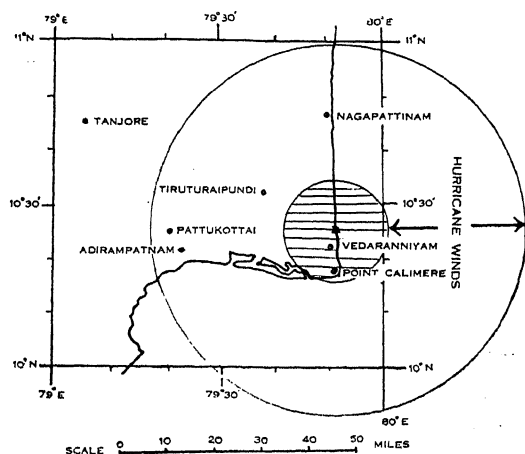


FIG. 3. Dimensions of the 'Eye' (Hatched Circle) and Region of Hurricane Winds at the time of Cyclone Crossing the Coast.

The highest wind speed reached in the cyclone can only be estimated indirectly as there was no instrumental record. From the severe nature of the damage caused, viz., bending of telegraph poles, uprooting of big trees, snapping of the trunks of trees of 4' to 5' diameters, shaking and collapses of strong buildings and roofs, etc., it has been estimated by some that wind speed may have reached 150 m.p.h. in gusts, while the lowest estimate is 80 to 90 m.p.h. From the very steep pressure gradient and the magnitude of the pumping of the barometric pressure at Nagapattinam as indicated by the barogram, it would appear that the wind must have reached a speed of over 100 m.p.h. and 150 m.p.h. in gusts may not be an overestimate. In the Masulipatam Cyclone of October 1949⁴ in which the central pressure was 977 mb. and the pressure gradient in the core of hurricane winds as estimated from Masulipatam barogram was only 1 mb. in 51 miles, an estimated wind speed of about 100 m.p.h. was reached. It should be remarked

that the area of hurricane winds need not necessarily be circular. In fact, it is known⁵ that in westward-moving tropical cyclones in the northern hemisphere, gales and hurricanes extend further to the north than to the south, which appears to have been the case in the Nagapattinam cyclone. The area of gales extended up to Madras, about 200 miles to the north of the centre. Towards the south, however, gales were experienced at Jaffna about 80 miles to the south of the cyclone centre, but not at Pamban, about 120 miles to the south-south-west. Tiruchirapalli, situated about 80 miles to the west of Nagapattinam, experienced gales after 3 p.m. and the strongest winds, about 50 to 60 m.p.h., were experienced at 7 p.m. to 8 p.m.

AIR MASSES INVOLVED IN THE CYCLONE

It is seen from the weather charts that the Nagapattinam cyclone originated as a depression in the south Bay on the inter-tropical front between Tropical Maritime (Tm) and Equatorial Maritime (Em) air. The Tm air was, however, conspicuously weak throughout the period of the cyclone. This cyclone apparently provides another instance of formation of a depression by the interaction of two air masses and of its rapid intensification with the development of a "Triple Point" when the depression moved westwards into the field of the Tropical Continental (Tc) current. There was clear indication that there was appreciable strengthening of northerly Tc air over the entire peninsula prior to the cyclone approaching the coast. There being no strengthening of the Tm air, Tm-Tc warm front or discontinuity was weak or inactive and the air masses involved in the cyclone were mainly Em and Tc. As such, the distribution of rainfall in this cyclone was somewhat like that in the south-west monsoon cyclones with the heavy rain in the south-west quadrant of the storm. Heavy rain exceeding 6" was reported by a number of stations within a belt of about 12 miles to the south of the storm track during the 24 hours ending 0830 hours I.S.T. of 1st December, principal amounts being Agastiyampalli (near Point Calimere) 9.1" and Alangudi 15.0". The lack of Tm air appears to have been responsible for the comparatively less rainfall to the north of the storm track and also for the short spell of heavy rain caused by this cyclone.

PREVIOUS SEVERE CYCLONES WHICH STRUCK NEAR NAGAPATTINAM

Examination of past records shows that in the last 62 years (1891-1952), 6 cyclones have

struck the coast near Nagapattinam in the north-east monsoon season October-December. Of these, 3 cyclones in November 1935, November 1939 and November 1952, have been severe. The severe cyclone of November 1935 had a track almost identical with that of the November 1952 cyclone. It struck the coast just to the south of Nagapattinam in the early hours of the 15th November 1935 and lay as a deep depression near Tiruchirapalli on the morning of the 15th. Thereafter, it moved rapidly westwards into the Arabian Sea by the next morning. It caused widespread heavy rain in south-east Madras where railway and other communications were considerably dislocated. Nagapattinam suffered considerable damage and thousands of trees were uprooted in the coastal districts. "The Hindu" of 19th November 1935 stated that "the storm which swept over Vedaranyam and Agastyampalli and Point Calimere on the 14th instant was one of the severest that was ever experienced within the last 40 years and it has played great havoc in this part of the country resulting in the

loss of human lives and countless cattle and damage to a thousand houses". Both the 1935 and 1939 cyclones were very much less deep and had less steep pressure gradients than the 1952 one, but caused more rain. A comparison of the structure and movement of these two previous Nagapattinam cyclones and of the Masulipatam cyclone of October 1949 with the present one is expected to reveal some interesting features.

A detailed technical study is being made and it is intended to publish the results in a paper in the *Indian Journal of Meteorology and Geophysics* in due course.

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FORTHCOMING INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCES, 1953

| Date | Subject | Organized by | Location |
|------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------|
| 1 June 16-24 | International Union of Pure and Applied Physics—Congress on Acoustics. | Prof. Kosten, Mijnbouwplein 11, Delft, Netherlands | The Hague, Delft, Hilversum and Eindhoven |
| 2 June 21-25 | Institute of Food Technologists—13th Annual Meeting. | The Secretary, University of Massachusetts, Amherst, Mass.- U.S.A. | Boston, Mass. |
| 3 June 24-26 | Organisation for the Advancement of Spectrographic Methods—16th Congress | Secretariat, 1 Place Saint Thomas d'Aquin, Paris | Paris |
| 4 June 24-26 | Colloquium on the Study of Water Molecules in Solids by Electromagnetic Waves | Secy., Centre Nationale de la Recherche Scientifique, 13, Quai Anatole, Paris | Paris |
| 5 July 5-11 | International Union of Pure and Applied Physics—Colloquium on Cosmic Rays | Prof. L. Leprince-Ringuet, 17, rue Descartes, Paris | Bagnères-de-Bigorre, France |
| 6 July 13-18 | International Astronomical Union—Symposium on Gas Dynamics of Interstellar Clouds | General Secy., Mr. P. Th. Oosterhoff, Leiden Observatory, Netherlands. | Cambridge, England |
| 7 July 14-25 | 6th International Congress of Radiobiology | Secy-General, Prof. Flemming Norgaard, Oster Voldgade 10, Copenhagen K, Denmark | Copenhagen |
| 8 July 22-25 | International Astronomical Union—Symposium on co-ordination of Galactic Research | General Secy. Mr. P. Th. Oosterhoff, Leiden Observatory, Netherlands | Groningen, Netherlands |
| 9 July 29-Aug. 4 | International Union of Pure and Applied Chemistry—17th Conference and 13th Congress of Physical Chemistry—Wood and Paper Chemistry | Secrétaire-General, 4, Avenue de l'Observatoire, Paris 6 | Stockholm |

ON COLD POOLS AND THEIR ROLE IN THE DEVELOPMENT OF NOR'WESTERS OVER WEST BENGAL AND EASTERN PAKISTAN

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DURING the pre-monsoon period, March to May, West Bengal and Eastern Pakistan and the adjoining areas are visited by thunderstorms of a severe type which are popularly known as nor'westers and which sometimes reach tornadic violence, causing heavy destruction of life and property. The mechanism of these thunderstorms has been investigated by a large number of meteorologists,¹⁻¹¹ but it is yet very imperfectly understood. Consequently, even to-day, the forecasting of nor'westers continues to be one of the most baffling problems in Indian Meteorology and the forecaster has often to fall back upon empirical methods for issuing timely warning against these thunderstorms.

It is clear from a perusal of the literature so far published on this subject that emphasis has been laid by most of the workers on the sea-level conditions and in the layers of the atmosphere below 10,000', especially between 3,000' and 5,000' where there is a marked inversion caused by the dry northwesterly winds (Tc) over-running the relatively colder and moist southerly winds (Tm) from the Bay of Bengal. As early as in 1937, however, Ramanathan and Ramakrishnan¹¹ pointed out that, in addition to the breaking down of the inversion, which is a fairly regular feature in the afternoons even on days of no nor'westers, the replacement of the normally warmer air over Bengal at 20,000' and aloft by colder air, would be necessary for the development of these thunderstorms. Their remarks were, however, of a general nature based on *average monthly temperatures* and *not on a study of individual cases*. This aspect of the problem subsequently received little attention by the later workers in this field, presumably because of the lack of sufficient upper air temperature data to confirm or contradict the views expressed by Ramanathan and Ramakrishnan.

The present authors have pursued this aspect of the problem by a study of the thickness patterns at the 700 and 500 mb. levels over north-east India and Eastern Pakistan during the nor'wester season. Seven spells of extensive nor'wester activity have been studied by this method.* Six of these spells relat-

ed to the nor'wester season of 1952 and one related to 7-3-49. The last-mentioned case was specially chosen because it was responsible for a record squall of 76 m.p.h. at the Calcutta Airport although there were very few indications in the charts for sea-level or upper levels below 10,000' to suggest the development of a nor'wester of this severity. Among the six spells in 1952, the one on 14-4-52 was also specially selected because it caused a severe squall at Calcutta in the afternoon from the east—a very unusual direction—for as long a period as one hour and blew away the revolving beacon from the terrace of the Control Building at the Calcutta Airport. In this case also, practically none of the conditions usually associated with nor'westers existed either at sea-level or anywhere below 10,000' a.s.l.

The thickness patterns at 700 mb. (1,000—700 mb.) and at 500 mb. (700—500 mb.) were drawn on the basis of the thermal winds and thickness values at these levels. The thermal winds were computed from the Pilot Balloon winds for 09 G.M.T. available for a large number of stations in India, Eastern Pakistan and Burma. The thicknesses were obtained from the Radiosonde data of 15 G.M.T. of the Radiosonde stations in India and Western Pakistan (total 12 in number).

A study of the seven cases† referred to above has revealed the following:

(a) In every one of the seven cases, 18-24 hours before the outbreak of the nor'westers, there was either a cold pool (*i.e.*, an area where there was at least one closed thickness line curving cyclonically) or a well-marked cold trough (*i.e.* an area in which the thickness lines were symmetrical and curved cyclonically) at the 500 mb. level in the area where the nor'westers developed. This time-difference between the first appearance of the cold pool (or cold trough) and the later development of nor'westers is of special importance in view of its usefulness in forecasting.

thunderstorms in middle latitudes. As far as the present authors are aware, a similar study has so far not been made with regard to thunderstorm-situations in India and Pakistan.

† These conclusions have been confirmed by one more case of extensive and severe nor'westers, *viz.*, on 18-4-1944.

* Mr. C. K. M. Douglas¹⁵ and others have studied the significance of thickness patterns in the development of

(b) The nor'westers tended to be a maximum in the sector of the cold pool or the cold trough where the thermal winds were between SSE and WSW.

(c) In six out of the seven cases, in the region where the thermal winds were between SSE and WSW, the actual winds had an appreciably greater westerly component than the thermal winds suggesting the possibility of further advection of colder air over that region.

(d) So long as there is a cold pool or cold trough at the 500 mb. level, one should always keep in mind the possibility of thunderstorms even if the charts for the sea-level and the lower levels in the upper air do not give clear indications of such a possibility. The case of 14-4-52 is a definite pointer in this direction. The streamlines on the constant level upper wind charts at 2,000' and 5,000' a.s.l. at 02 G.M.T. on 14-4-52 are shown in Figs. 1 and 2 and the

situations which nor'westers did not develop over West Bengal although the sea-level and the upper air conditions below 10,000' were

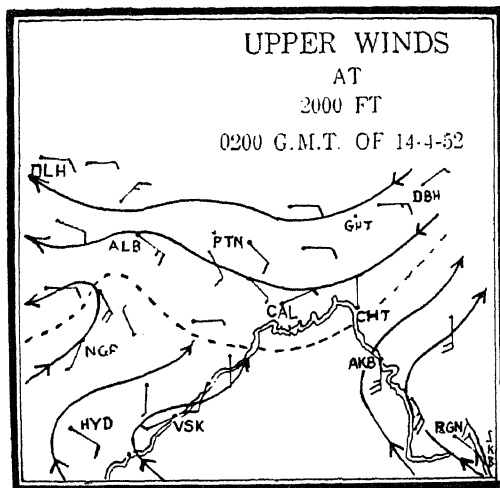


FIG. 1.

thermal winds and thickness patterns at the 500 mb. level on the evening of 13-4-52 are shown in Fig. 3. The thunderstorms which developed between the afternoon of 14-4-52 and morning of 15-4-52 are superposed on the thickness patterns in Fig. 3. It is of special interest to note here that the weather travelled most unusually from Gangetic West Bengal to Chotanagpur on this afternoon and that the nor'westers over Gangetic West Bengal were not associated with any earlier development in Eastern Pakistan or Lower Assam. The thunderstorms over Aijal and Chittagong shown in Fig. 3 were an independent development and occurred in the early hours of 15-4-52.

In addition to the above seven cases, the authors have also made a general study of

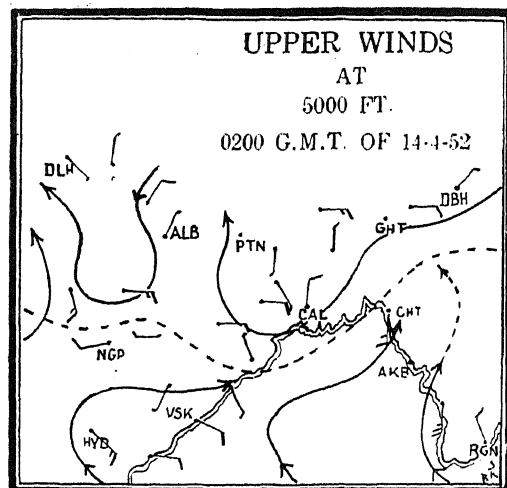


FIG. 2.

favourable according to the present accepted ideas. On such occasions, it has been found that there was no cold pool or even a weak cold

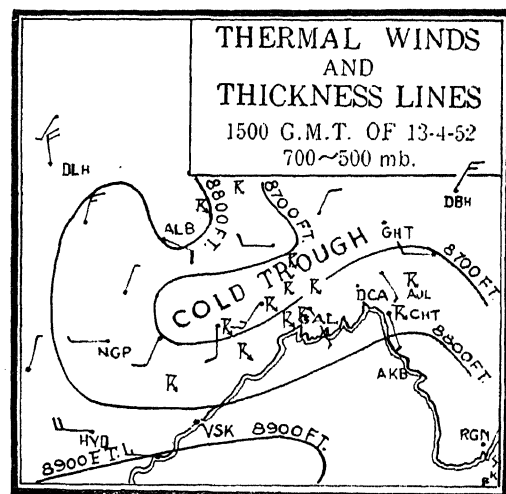


FIG. 3.

trough at the 500 mb. level in or near the region where nor'westers could be expected from other evidence. The situations on 2nd and 11th March and 2nd April ‡ 1953, are instances in support of this statement.

The authors would have liked to study in detail the thickness patterns at the 300 mb. level

‡ Added at proof stage.

(500 — 300 mb.) also but the paucity of thermal wind data for this level discouraged them from undertaking the study at this stage. They would, however, like to mention that in the cases of nor'wester activity on 5-6-52 and 6-6-52 for which adequate amount of thermal wind and thickness data were available, there were very well-marked cold troughs at the 300 mb. level also, 18-24 hours before nor'westers developed. The thermal winds (500 — 300 mb.) in these cases were SSE/SW over the entire region where the nor'westers developed while the actual winds in the same region were SW/W.

From the above, the authors are tempted to conclude that the advection of colder air between 10,000' and 20,000' and possibly also between 20,000' and 30,000' appears to be the final determining factor in the outbreak of nor'westers, at least when they are widespread.

In conclusion, it may be pointed out that the technique adopted by the authors in this investigation is a simple one, not open to any theoretical objection from the point of view of validity of the geostrophic assumption, as the phenomena of nor'westers occur in regions to the north of latitude 20° N. and during a period of the year when the westerlies are predominant over north-east India and Eastern Pakistan in the upper air. Further, there is usually a fairly adequate amount of Pilot Balloon wind data at the 500 mb. level over India except on

very cloudy days and the accuracy of these data is quite well known. Consequently, it is possible to identify the existence of cold pools or cold troughs qualitatively even from the thermal wind circulation patterns on days on which Radiosonde data are not available or are not reliable on account of instrumental errors.

Full details of the seven cases referred to above, together with diagrams showing the thermal winds and thickness patterns at the 500 mb. level and the thunderstorms superposed upon these patterns for purposes of comparison are being sent for publication in the *Indian Journal of Meteorology and Geophysics*.

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MENDELIAN ANOMALIES

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THOUGH over fifty years have elapsed since Mendel's Law of Segregation was rediscovered by three different investigators, De Vries, Correns and von Tschermak in 1900, no attempt apparently seems to have been made to collect systematically Mendelian anomalies, occasionally observed in experimental data and scattered in the genetic literature. Not without exception every population has a classical Mendelian ratio of 3 : 1, etc. Thus in the course of intensive genetic research during the past fifty years, it has not been a rare observation that abnormal segregations in families, arising from various crosses, have been recorded by different authors, who have also expressed doubts in regard to offering an explanation on ordinary Mendelian lines. For example, Luther Smith⁸ in his review on genetics and cytology of barley has rightly remarked, "Workers who have studied many genetic characters have noted that not all F₂ segregations are

exactly 3 : 1, although only one gene pair is involved. There are a number of possible reasons for this discrepancy between theoretical and observed ratios. However, not many workers have taken the time and trouble to determine which of the possibilities actually obtain".

Yule¹⁴ reporting on the data afforded by the experiment initiated by Derbyshire, remarked, "No explanation is offered of the remarkable divergences from the expectation based on simple Mendelian theory; they remain a puzzle. But it seems clear that the theory is inadequate completely to explain all the facts. The mechanism at work appears to be more complex than is commonly postulated". Also Bateson's¹ remarks in this connection that "even as regards the outline of genetical principles, finality has not been attained," may not be out of place to record.

Again, Pease¹⁰ working on the inheritance of

weights in rabbits, recorded, "A plausible explanation of this on ordinary Mendelian lines does not seem possible".

There also exists enough evidence to show that a particular character is determined by one pair of factors in a particular set of experiments while in another set the same character was determined by two pairs of factors or even more. Such cases are not infrequently recorded in the genetic literature on rice,⁷ where out of 189 pairs of characters analysed, 40 show such inconsistent inheritance. Cases have also been recorded by some workers where results agreed not with the expected ratio but with other values.²

It is also not very rare to find that out of a large number of F_2 families in a particular cross, grown from individual F_1 plants, one or more, showing significant deviations.

In the course of our work, we have made a critical survey of genetic literature from this point of view and classified the data on Mendelian anomalies into five different types as given below, to prepare a code of these deviations.

CLASSIFICATION OF MENDELIAN ANOMALIES

(a) Ordinary Deviations

Generally, in an experiment on Mendelian segregation involving one pair of genes, the different populations belonging to the dominant character bear to the populations belonging to the corresponding recessive character, ratios both greater and less than three for different families of a generation. Similar conditions hold good in cases dealing with more pairs of genes. In such a case the statistically significant deviation is said to be of the ordinary type.

(b) Unidirectional Deviations

When for different families of a generation, the ratios of segregation are all either greater than or less than the expected values, the deviation is said to be unidirectional.

(c) Evolutionary Deviations, i.e., Deviations Observed in the Generations F_n, F_{n+1}, \dots

When the ratio of segregation tends to either decrease or increase as we go upward in the generations F_n, F_{n+1}, \dots the deviations are said to be evolutionary. It is suggested that due to the action of an evolutionary factor, the trend of deviations in the series F_n, F_{n+1}, \dots is directed towards a definite genetic equilibrium.

(d) Aberrant Segregations

Those segregations which cannot strictly be assigned to the Mendelian type, are said to be aberrant and they ought to be called Mendelian puzzles,

(e) Inconsistent Inheritance

It is not very rare to observe a particular pair of characters being controlled by, say, one pair of genes in some cases and the same pair of characters controlled by two or even more independent pairs in other cases. Such cases of inheritance are examples of inconsistent inheritance.

It is envisaged that the above code might help those interested in the subject to offer explanations or formulate corollaries to Mendel's Law of Segregation, such as the Hardy-Weinberg Law, connected with population genetics. (Sinnott, Dunn and Dobzhansky¹²).

In this connection, Bateson¹ once remarked that "though we can no longer doubt that segregation is, perhaps by more than one process, commonly effected at the reduction division, evidence steadily accumulates showing that at least in plants of many kinds comparable segregations occur in somatic divisions also". Naturally, this constitutes one of the factors responsible for the complexity of the phenomena of segregations. Unless the interrelations and inter-actions of somatic divisions on one hand and reduction divisions on the other, are thoroughly understood, the complexity will continue to be a puzzle. The recent cytological investigations carried out by Huskins and his co-workers,^{4,5} Wilson and Cheng,¹³ Huskins and Cheng⁶ and Menzel and Brown⁹ on chromosome multiplication and reduction in somatic tissues and somatic segregation, require further extension and application since these authors have not thrown any light on the bearing of these biological processes on Mendelian heredity. For this very reason Franzke and Ross³ remarked, "If this phenomenon is more than an apparent separation, it is surprising that some mention of effects on heredity resulting from such chromosomal separations has not been made". These authors found, "Colchicine treatment of full sibs of a true breeding variety of sorghum gave variants possessing a number of ancestral characteristics of which some bred true immediately. Untreated stock of a full sib of the above has not segregated in subsequent generations. In no case among these has the chromosome number been found changed". Considering the question of segregation observed in F_2 progenies from treated F_1 and untreated F_1 plants, it is very significant to observe that the results of segregation in F_2 progenies in the case of height of plants, were different in these two cases. "The distribution from progeny of treated F_1

plants shows a definite concentration around one point causing a distinct difference in form of this distribution from that of the untreated which approaches that of a normal curve. This and the lower mode of the progeny from treated F_1 plants demonstrates a significant difference in degree of uniformity found within progenies from treated plants as against progenies from untreated plants". Thus colchicine treatment causes homozygosity in respect of height of plants thereby modifying the normal segregation. So far as we know, none has carried such investigations, a step ahead to examine the nature of the resulting anomalous segregations in generations like F_2 , F_3 , etc. A contribution to Mendelian anomalies coming from this direction, is yet to be settled.

Richharia¹¹ had also made similar observations on colchicine-induced variants in respect of oil percentages in *Sesamum orientale*. He found that colchicine treatment of plants of a true breeding variety of sesame gave variation

in respect of oil percentages between 51.21 and 54.13, whereas the normal progenies varied between 51.19 and 53.80 per cent.

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STREPTOMYCIN AND ISONIAZID

THE Second Report* to the British Medical Research Council by the Tuberculosis Chemotherapy Trials Committee gives the results of three months' treatment of 364 patients suffering from pulmonary tuberculosis of different degrees of severity. Of these, 142 were treated with streptomycin 1 g. daily and isoniazid 100 mg. twice a day, 102 with streptomycin 1 g. daily and sodium para-aminosalicylate (P.A.S.) 20 g. daily, and 120 with isoniazid 100 mg. twice a day alone. Over this period streptomycin and isoniazid, given together, were superior to streptomycin and P.A.S. in their effect on weight gain and blood sedimentation rate, and rather more effective in improving general condition. There was no significant difference in the effect on pyrexia, sputum-conversion or the radiographic appearances. Comparison of streptomycin and isoniazid with isoniazid alone, over the same period, showed that the combined treatment was much more effective in lowering the sedimentation rate and improving the radiograph. It was slightly more effective in returning the temperature to normal. The effect on general condition and on weight was similar with both treatments.

When streptomycin and isoniazid are given together, the reciprocal suppression of drug resistance is of the same order as that of streptomycin and P.A.S. over a three-month period. But the few available figures for isoniazid resistance at four months are less reassuring. Three out of eight positive cultures were resistant, though in most of these patients streptomycin was given only three times a week in the fourth month. Until more evidence is available, these results suggest caution in giving streptomycin less often than once daily when it is used with isoniazid, and we do not know that the combination will maintain its clinical superiority when continued for more than three months.

The chemotherapy of tuberculosis is no longer simple. Its very success and diversity are creating ever-changing problems with which everyone who treats the disease must become familiar. The pace of research is such that even the conclusions of the present authoritative report may be out of date in a few months.

* *B. M. J.*, March 7, 1953, p. 521.

DR. GILBERT J. FOWLER—OBITUARY

DR. GILBERT JOHN FOWLER, who died on March 21, 1953, at Bangalore, was a great authority on the subjects of treatment of sewage and trade effluents and of nitrogen conservation. He will be principally remembered as the pioneer of the Activated Sludge Process, which is perhaps the most efficient and hygienic method of sewage treatment so far developed.

Gilbert John Fowler was born in Paris on January 23, 1868. He was educated at Owen's College, Victoria University, Manchester, where he became a Demonstrator in Chemistry after taking his B.Sc. Degree. Later he was appointed a Lecturer in the University of Manchester and Consulting Chemist to the Rivers Committee of Manchester Corporation. During this period (1896-1916) he was responsible for the treatment of sewage and trade effluents of Manchester. He was awarded the D.Sc. Degree of the University of Heidelberg in 1904. He won international reputation when he and his associates, particularly the late Dr. E. Arden and Mr. W. T. Lockett, developed at Manchester the Activated Sludge Process in 1914.

On problems of sewage disposal Dr. Fowler was consulted by the cities of New York, Cairo, Shanghai and Hankow, and by the Government of Federated Malay States. He was also a consultant to the Government of India and to various State Governments. He had been periodically visiting India in an advisory capacity from 1906 and in February 1916 he took his permanent residence in India when he became the Professor of Applied Chemistry and later (1921) of Biochemistry in the Indian Institute of Science, Bangalore. Even after his retirement from the Institute in 1924, he was taking very keen interest in the activities of the Department. Excepting for brief periods, e.g., when he was the Principal of the Harcourt Butler Technological Institute at Kanpur (1927-29), he was throughout in Bangalore.

One of the most important lines of work in the Department of Biochemistry since Dr. Fowler's association with the Department has been naturally concerned with the scientific control of sewage and refuse disposal in all its aspects including its relation to agriculture. In 1922 an activated sludge plant was designed and set

up at the Institute capable of dealing with the sewage from a campus of 400 people. This installation has enabled important fundamental research to be done on the biochemistry of the process which has thrown considerable light on the mechanism of aerobic purification of sewage. After a visit to Rothamsted in 1921 when he became acquainted with the so-called ADCO process, Dr. Fowler took a great interest in the production of compost. Since then the subject has become one of the leading manurial activities of India and many students of the Biochemistry Department have taken an important part in the work throughout the country. He was continually interested in activated sludge, in compost and in other aspects of recovery of nitrogen from waste materials for soil fertilisation and crop production. In articles, in lectures and addresses he was not tired of developing and enlarging his most favourite theme of nitrogen conservation.

Dr. Fowler has written three books, viz., *Sewage Works Analyses* (1902), *An Introduction to Bacteriological and Enzyme Chemistry* (1911) and *An Introduction to the Biochemistry of Nitrogen Conservation* (1934), a pamphlet entitled *Energy and Economics—A Plea for a New View Point* (1941), and a large number of papers and articles in various journals. He was the Technical Representative of Messrs. Activated Sludge, Ltd., London, for India and the East from 1925. He was a Fellow of the Royal Institute of Chemistry (and the Hon. Corresponding Secretary for India till 1951); Fellow of Chemical Society of England; Fellow of the Royal Sanitary Institute; Hon. Member of Manchester Literary and Philosophical Society; and Member of Industrial Research Council of the Government of India, 1937-39. He was President of Chemical Section of Indian Science Congress in 1918; of Indian Chemical Society in 1927; and of the Society of Biological Chemists, India, 1947-49.

Dr. Fowler was held in high esteem and regard by those who came into contact with him. He is survived by his wife and two sons.

K. V. GIRI.

R. RAJAGOPALAN.

S. C. PILLAI.

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A GENERAL THEORY OF DISCRIMINATION WHEN THE ALTERNATIVE POPULATION DISTRIBUTIONS INVOLVE UNKNOWN PARAMETERS

THE problem of discrimination, that is of assigning an observed individual to its proper group, admits a simple solution when the distributions of measurements in the alternative populations are completely specified. In practice, the alternative distributions are not completely known but may be estimated on the basis of samples drawn from each alternative population. It can be formally demonstrated that if the parameters are based on large samples, then the above solution in which the estimates are substituted for parameters is asymptotically the most efficient. The small sample case needs some investigation. The problem may be stated as follows:

Two samples of sizes n_1 and n_2 are available from two populations $P_1(x/\theta_1)$ and $P_2(x/\theta_2)$, where x stands for all the measurements and θ for all the parameters. An individual with known measurements y has to be assigned as a member of one of the two groups basing the decision on the observed values only, the para-

meters occurring in the alternative distributions being unknown. Wald¹ proposed to solve this problem in the case of p -variate normal populations by finding the distribution of the estimated discriminant function earlier suggested by Fisher for classificatory purpose. This involves unknown parameters and cannot, therefore, be applied in practice. In this note an attempt is being made to lay down a decision rule independent of the unknown parameters.

If the measurements are p in number, we have a total of $(n_1 + n_2 + 1)p$ observations which can be represented by a point in a Euclidean space. The decision rule requires the division of the space into two regions R_1 and R_2 such that when the point of observations falls in R_1 the individual is assigned to the first group and otherwise to the second. Whatever may be the set of regions, it should have the property that errors of classification when the alternative populations are different must be smaller than those when the populations are the same. This criterion leads to the restriction that the size of each region should be the same whenever the two probability densities P_1 and P_2 are identical irrespective of what

the actual values of the common parameters are. This part of the problem is immediately solved if similar regions exist with respect to all the unknown parameters when the probability densities are the same.

We have now to fix the size of the regions $a_1(\theta, \theta)$ and $a_2(\theta, \theta)$ of R_1 and R_2 when P_1 and P_2 are identical. When the population distributions are identical, the decision may be equivalent to that of tossing an unbiased coin so that it is reasonable to take $a_1 = a_2 = \frac{1}{2}$. We could also fix them by assigning the ratio of errors of classification at a specified set of parameters in the two different distributions. The special case of fixing $a_2(\theta, \theta)$ at the 5% level leads to a test of the null hypothesis that the individual belongs to the first group at level $\leq 5\%$, the alternative being the second group. Similarly, the other null hypothesis can be tested.

The problem is now to determine such similar divisions R_1, R_2 covering the entire space which have fixed values when the two distributions are identical and for which the errors of classification is a minimum. In many cases, similar regions are constructed by choosing portions from surfaces of constant values of sufficient statistics. The problem of minimising the errors reduces to suitably dividing the region common to the surfaces of sufficient statistics as in the general problem of testing composite hypothesis.

Again, in all cases, no uniformly best division is possible on the surfaces of sufficient statistics. We may then determine regions for which the errors of classification is least, at least locally, i.e., for small departures from the equality of populations.

By using these principles, it has been possible to solve the discrimination problem as well as testing of hypothesis in a number of cases including multivariate normal distributions by just utilizing the observed values only and making no assumption about the unknown parameters.

The theory is general and can be applied even when the alternative distributions are more than two. The detailed mathematical treatment will be published elsewhere. Related problems of selection, greater mean, etc., can also be easily solved by this method.

Statistical Laboratory, C. RADHAKRISHNA RAO.
Presidency College, Calcutta-12,
February 24, 1953.

OCCURRENCE OF GYPSUM IN PALLADAM TALUK, COIMBATORE DISTRICT

THE whole area near Anuppapatti village, Palladam taluk, is a vast stretch of black cotton soil extending to thousands of acres and the topography is very undulating with heavy formations of gullies due to soil erosion. Gypsum occurs as modules of varying sizes both in the profile and as an outcrop as well in a basin covering about 200 acres. The profile deposits are present at a depth of 2'-8' depending on the topography. Blocks of granites, gneisses and *kankar* of different sizes are found on the surface.

The clay content of the soil ranges between 48 to 55 per cent., the lower depths being heavier than the surface and subsoil. The soils are alkaline in reaction (pH 8.2 to 8.6) and contain high amounts of water-soluble salts, mostly the sulphates of sodium, calcium and magnesium; the carbonates and bicarbonates of sodium being completely absent. The water-soluble salt content also shows an increase with depth, the lower depths having higher concentrations than the surface and subsoil. A petrological analysis of the samples reveal the presence, in addition to gypsum, of the following minerals, viz., quartz, ferro-magnesium minerals, etc. Gypsum is found associated with *kaolin* and *kankar*, the latter being present throughout profile either in a nodular form or as streaks.

The soils of this area are similar to the black cotton soils with gypsum occurring in the Rayalaseema (Ceded Districts) in all respects, viz., parent material, mode of formation, salt concentration, texture and other physical characteristics.

In view of the absence in the soil of salts toxic to plants or inhibitory to their growth in the top zones, the high lime status and the dry intensive cultivation that is being followed, the area would continue to support good vegetation provided suitable precautions are taken against soil erosion and consequent depletion of soil fertility.

The formation of a zone of gypsum concentration is only secondary which may be due to the absence of heavy leaching and to the high retentive and absorptive capacity of the clay complex present in the soil. The gypsum nodules contain the hydrated sulphate of lime in a crystalline form, crystallised in the monoclinic system in flat rhomboid tables and the crude material as obtained fresh from the field contains 65% CaSO_4 . A rough estimate puts

the probable quantity that could be obtained from one acre at about 400 tons of the crude material. A detailed paper incorporating complete analytical data will be published shortly.

Chemistry Section, M. SANYASI RAJU.
Agric. Res. Institute, C. R. VENKATRAMAN.
Lawley Road P.O., Coimbatore,
February 12, 1953.

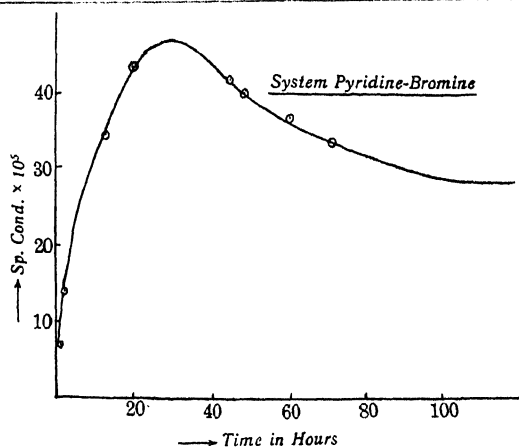
A NOTE ON THE REACTION BETWEEN PYRIDINE AND BROMINE IN THE LIQUID STATE

IN continuation of the author's previous work on the pyridine-iodine¹ system, the reaction between pyridine and bromine has been investigated at 20° C. by studying the time-variation of specific conductivity of bromine solution in pyridine. The colour of the solution just after adding bromine is golden yellow, but changes to deep reddish brown when kept for 2-3 days. The accompanying table gives the changes in sp. cond. with time.

TABLE

(Temperature 20° C.; Conc. of Bromine 2.92 gm./l. or 0.0180 M. Specific Conductivity of Pyridine is about 9×10^{-8} mhos)

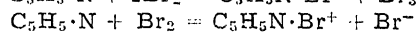
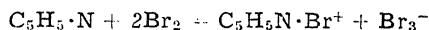
| Time | Sp. cond. in mhos |
|----------|------------------------|
| 20 mins. | 6.705×10^{-5} |
| 2 hrs. | 1.350×10^{-4} |
| 13 " | 3.490 " |
| 19 " | 4.336 " |
| 44 " | 4.180 " |
| 48 " | 4.011 " |
| 60 " | 3.665 " |
| 71 " | 3.398 " |
| 599 " | 2.885 " |



From the table it appears that the conductivity first rises but then falls off slowly. This

behaviour is somewhat different from that of iodine in pyridine where conductivity goes on rising, probably attaining the maximum value at infinite time. The nature of variation is clearly brought out by the accompanying figure.

The colour change from golden yellow to the deep brown is very rapid and marked, and is unlike the slow colour change of the pyridine-iodine system. The rise in electrical conductivity with time may be tentatively accounted for, as for the pyridine-iodine system, due to the formation of ionic species of the type



It is, however, not clear what reaction is responsible for the slow disappearance of these ionic species in the present case.

Detailed investigation is in progress to elucidate these points and the results will be published in detail elsewhere.

Chemistry Dept.,
Lucknow University,
February 20, 1953.

RAM GOPAL.

1. *J. Ind. Chem. Soc.*, 1952, p. 898.

EFFECT OF BORIC ACID ON THE ACTIVITY OF INVERTASE

It is well known that boric acid forms a complex with sucrose which is taken advantage of in its quantitative estimation.¹ It was, therefore, thought of interest to examine how the catalytic activity of invertase is affected by the presence of boric acid in the reacting system.

The invertase sample used for the investigation was the same as described previously.² The stock invertase preparation had a time value of 58 minutes per c.c. In the present work we have taken arbitrarily the activity of invertase present in 1 c.c. of this preparation as 100 units, and measured the activity of other solutions in terms of this standard.

The number of milligrams of invert sugar produced by different quantities of stock invertase preparation was determined by following a special procedure.³ A graph is then constructed by plotting the number of milligrams of invert sugar produced against the number of arbitrary units of invertase used. The activity of any other preparation can then be found out by determining the number of milligrams of invert sugar produced under specified experimental conditions and referring to the graph.

To study the effect of boric acid, 2.5 c.c. of the concentrated invertase (1 c.c. = 100 units)

is diluted to 100 c.c. by buffer solution of required pH using as much quantity of saturated solution of boric acid as is required to give a particular concentration of boric acid in the final solution. The mixture is kept at 25° C. for 5 minutes and the activity is determined as described earlier.³ The results obtained with different quantities of boric acid at different pH values show that the activity of invertase is brought down by about 20 to 25 per cent. by the presence of 6.7 per cent. boric acid in the reacting mixture. Further work is needed to decide as to how far this effect is due to the complex formation between sugar and boric acid and that between invertase and boric acid.

Ind. Inst. of Sugar Tech., K. S. G. DOSS.
Kanpur, H. C. SARASWAT.
December 17, 1952.

1. Clowes, F. and Colman, J. B., *Quantitative Chemical Analysis*, 13th Ed., J. & A. Churchill Ltd., London, 1931, 150. 2. Doss, K. S. G. and Saraswat, H. C., *Proc. Ind. Acad. Sci.*, 1952, **36**, 343. 3. —, *Ibid.*, 1953, **37**, 63.

ESTIMATION OF *p*-CYMENE BY OXIDATION TO TEREPHTHALIC ACID

THE semi-quantitative method of estimating *p*-cymene by its oxidation to terephthalic acid, developed by Linstead and co-workers,¹ was tried in our investigations. Pure *p*-cymene (b.p. 176-76.5° C., n_D^{20} 1.4890), obtained by purifying an Eastman Kodak sample, was oxidised, and the results are summarised in Table I-A, the yield of terephthalic acid being 425 mg. as compared to 370 mg. reported by Linstead *et al.*, and not much altered by increasing the weight of CrO_3 to 4 g.

Trial experiments revealed that the discrepancy between our and Linstead's results might be due to the mode of carrying out the oxidation process. If, at the start, the oxidation is made to take place vigorously, the yield of terephthalic acid is greater than the yield obtained with a mild and slow heating from the beginning, as is seen by comparing the results of Tables A and B. The yield of acid from slow oxidation is similar to that obtained by the other authors.

For the sake of comparison, the unpurified Eastman Kodak *p*-cymene was subjected to the rapid and to the slow oxidation under otherwise identical conditions, and the results obtained are included in C and D of Table I. It is to be noted that the rapid oxidation brings out quite clearly the difference between the

purified and unpurified samples of *p*-cymene (A and C of Table I), whereas the slow oxidation procedure gives approximately the same amount of terephthalic acid for the two samples of *p*-cymene (B and D of Table I) and therefore appears to be non-specific.

Also an attempt was made to evaluate the effect of changing the relative proportions of sulphuric and acetic acids on the yield of terephthalic acid from purified *p*-cymene under rapid oxidation conditions, and the results are presented in E of Table I. The yield is now pushed up to about 474 mg. The result obtained with this more favourable acid mixture and rapid oxidation from unpurified *p*-cymene sample is given in F of Table I. The *p*-cymene content of this latter sample, on the basis of the purified sample as cent. per cent. works out to be 93 per cent. A similar calculation applied to the yields from the two samples of *p*-cymene with the lower acid content mixtures and rapid oxidation (A and C of Table I) leads to a value of 93 per cent. The identity of these two values seems to confirm the validity and reproducibility of the rapid oxidation procedure and of estimation of *p*-cymene content of a given sample by this method.

On replacing CrO_3 by the more readily available and less hygroscopic potassium dichromate, rapid oxidation of purified sample of *p*-cymene, gave an average yield of 475 mg. of terephthalic acid (cf. G of Table I), fairly close to the yield of 472 mg. obtained with CrO_3 (cf. E of Table I).

TABLE I

Oxidation of *p*-cymene to terephthalic acid
(time, 3 hrs.)

| | CrO_3 in g. | Water c.c. | H_2SO_4 c.c. | CH_3COOH c.c. | <i>p</i> -cymene mg. | Terephthalic acid (T) mg. | T in mg. per 450 mg. of <i>p</i> -cymene |
|---|----------------------|------------|------------------------------|-------------------------------|----------------------|---------------------------|------------------------------------------|
| A | 3.5 | 15 | 5 | 15 | 406 | 383 | 425 |
| B | 3.5 | 15 | 5 | 15 | 399 | 319 | 359 |
| C | 3.5 | 15 | 5 | 15 | 405 | 356 | 396 |
| D | 3.5 | 15 | 5 | 15 | 409 | 332 | 365 |
| E | 3.5 | 15 | 10 | 20 | 413 | 435 | 474 |
| F | 3.5 | 15 | 10 | 20 | 439 | 429 | 439 |
| G | 3.0* | 15 | 10 | 20 | 416 | 440 | 476 |

A and E, pure *p*-cymene, rapid oxidation; B, pure cymene slow oxidation; C and F, impure cymene, rapid oxidation; D, impure cymene, slow oxidation; G, pure cymene, rapid oxidation with potassium dichromate,

* CrO_3 equivalent of $\text{K}_2\text{Cr}_2\text{O}_7$.

For the present, it may be concluded that 450 mg. of pure *p*-cymene should, on rapid oxidation with CrO_3 , give 425 mg. of terephthalic acid with the acid mixture indicated in A of Table I. and about 475 mg. with the higher acid mixture of E of Table I. This latter yield can also be obtained with potassium dichromate as indicated by G of the same table. The reason for the reduced yields of terephthalic acid on slow oxidation and the nature of the experimental conditions for securing yields approaching the theoretical value are under investigation.

M. LEO XAVIER.

JAMES VERGHESE.

LOURDU M. YEDDANAPALLI.

Dept. of Chemistry,
Loyola College, Madras-6,
January 30, 1953.

I. Linstead, R. P., Michaelis, K. O. A. and Thomas,
S. L. S., *J. Chem. Soc.*, 1940, 1139.

EVIDENCE FOR COMPLEX FORMATION OF IODINE WITH SOLVENTS

THE general opinion seems to be that iodine forms a complex with solvents having an electron-donor group. Such a co-ordinated link might polarise the iodine molecule and make it more reactive.¹

Mixed solvents were used by us to study the effect of the progressive increase of such complex molecules. The effect of iodine complex is very pronounced with systems of water-ethanol mixtures in the reaction between sodium formate and iodine and the photo-chemical reaction between potassium oxalate and iodine. The rate of reaction is faster with greater proportions of alcohol.

The hydrolysis of iodine in water solutions (without KI) according to the equation $\text{I}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HIO} + \text{HI}$ in presence of platinum as catalyst is accelerated by the addition of alcohol. Specific conductivity measurements at intervals show an increase in conductivity with time in all the cases, but the rate of this zero order reaction increases with greater proportions of alcohol.

Loosening of the binding force between I-I by the formation of complexes must considerably strain the bond I-I and make it more easy for atomisation or to bring into chemical reaction with other substances. Our preliminary experiments show that there is increased light absorption with increased reactivity in such iodine complexes, also in mixed solvents like water-alcohols, water-dioxane and water-acetone

mixtures, thus adding proof to the earlier work of Dhar and Bhattacharya.²

Chemistry Dept.,

A. K. BHATTACHARYA.

University of Saugar,

N. R. SUBBARATNAM.

December 20, 1952.

1. Feigl and Bondi, *Monatsh.*, 1928, **49**, 417. 2.
Dhar and Bhattacharya, *J. Ind. Chem. Soc.*, 1934, **11**, 311.

EFFECT OF LIPID EXTRACTION ON DIPHTHERIA ANTITOXIC PSEUDOGLOBULIN

It is well known that liquid antitoxic sera lose 5 to 10 per cent. of their potency every year even when stored in cold. This deterioration can be avoided by lyophilisation of the liquid sera. However, the lipoproteins present in liquid sera get denatured and become insoluble during lyophilisation.¹ Lahiri² has been able to increase the solubility of the lyophilised product by previously extracting the liquid sera with ether at 0° C. in presence of 0.1 per cent. sodium taurocholate. Other workers³⁻⁸ have used mixtures of alcohol and ether at temperatures below -10° C. Mixtures of alcohol and ether are very efficient solvents for lipoids but the extraction has to be carried out at low temperatures in order to avoid denaturation and loss of antibodies.

We have been working on a method of lipid extraction which can be used at room temperatures without loss of antibodies. The process worked out was such that it fits in easily into the Gibson-Murdick^{9,10} method of concentration of antitoxic sera used in our laboratories for large-scale work. The method finally adopted for lipid extraction is briefly as follows.

The pressed cake of anti-diphtheria horse serum pseudoglobulin fraction precipitated by ammonium sulphate between 30 and 50 per cent. saturation was dried in a desiccator to less than 1 per cent. moisture content. To every 50 g. of the dry powdered material in a 250 ml. centrifuge tube, 100 ml. of a mixture of equal volumes of freshly distilled ether and absolute alcohol were added, shaken for 10 minutes and centrifuged. The clear solvent layer was decanted. The residue was mixed with 50 ml. more of the solvent and extracted as before. In all, three extractions were carried out. The precipitate was finally washed with 50 ml. of ether and de-etherised by exposing it to air in thin layers and finally dialysed. It was found after dialysis that there was a large amount of precipitate which could be removed by adjust-

ing the pH to 5.5. The clear supernate contained all the antibodies.

Seven lots of anti-diphtheria horse plasma were processed in this manner. In no case was there a loss of antibody, but, on the other hand, there was an increase in antibody titre ranging from 11 to 42 per cent. per g. of protein nitrogen as compared with the controls.

Electrophoretic analysis of the lipid extracted and unextracted sera were carried out in the Hilger electrophoresis apparatus at pH 7.6 in phosphate buffer of 0.1 ionic strength. Figs. 1

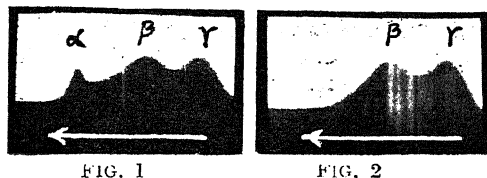


FIG. 1. Concentrated anti-diphtheria horse pseudo-globulin.

FIG. 2. Lipid extracted concentrated anti-diphtheria horse pseudo-globulin.

and 2 are the ascending patterns for unextracted and extracted samples respectively. It is seen from the photographs that the peak for alpha-globulin is missing in the extracted sample. The increase in antibody titre of the lipid extracted sample is thus due to the removal almost completely of the alpha-globulins which have no antibodies associated with them. The conversion of soluble alpha-globulins into water-insoluble proteins after lipid extraction does not seem to have been noted by others. Details will be published elsewhere.

The authors wish to thank Dr. D. C. Lahiri and Dr. P. M. Wagle for their keen interest and help.

Dept. of Antitoxins & Sera,
Haffkine Institute,
Bombay-12,
February 18, 1953.

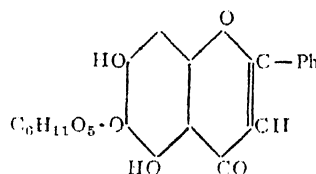
V. Y. MORE.
S. S. RAO.

TETUIN, A GLUCOSIDE FROM THE SEEDS OF *OROXylum* *INDICUM* VENT.

DETAILED examination of the seeds of *O. indicum* Vent. yielded the following substances: (1) A non-drying fatty oil;¹ (2) a yellow crystalline substance (m.p. 274° C.);¹ (3) Baicalein;² and (4) a pale yellow crystalline substance (m.p. 112-14° C., sintering at 77-78° C.) named Tetuin.

Tetuin, $C_{21}H_{26}O_{10}$, has been isolated from the alcoholic and water extracts of the defatted powdered seeds. Tetuin on hydrolysing with dilute mineral acids gave Baicalein, $C_{15}H_{10}O_5$ (m.p. 265-66° C.), and glucose, both of which have definitely been identified by the study of the properties and reactions of these substances and their derivatives.

The fact that Tetuin does not give green colour with alcoholic ferric chloride shows the absence of two hydroxyl groups in the ortho-position to each other. This is supported by the fact that it does not give ammonium molybdate acetic acid test for ortho hydroxyl groups.³ Oroxylin-A, a yellow colouring matter obtained from the root bark of *O. indicum* Vent. does not answer this test.⁴ Our results, therefore, indicate that Tetuin is Baicalein-6-glucoside and has the following structural formula.



Details of this investigation will shortly be published elsewhere.

L. M. College of Pharmacy,
Ahmedabad,
January 5, 1953.

C. R. MEHTA.
T. P. MEHTA.

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SEPARATION AND ESTIMATION OF OVER-LAPPING AMINO ACIDS BY CIRCULAR PAPER CHROMATOGRAPHY USING DIFFERENT SOLVENT MIXTURES

ALTHOUGH the technique described before¹ gave generally adequate separation of most of the amino acids occurring in the protein hydrolysates, several groups of amino acids were unresolved by it, e.g., the separation of glycine-serine-aspartic acid from each other, or of glutamic acid from threonine was difficult with

butanol-acetic acid-water as solvent mixture. Each group of these amino acids appears as one band on the chromatogram. In order to facilitate resolution of mixtures of such overlapping amino acids, recourse was had to the application of the following technique:

The overlapping amino acids which separate together as one single band with *n*-butanol-acetic acid-water solvent, was cut out and a separate chromatogram was run for each group of amino acids using pyridine-water solvent, the cut out paper strips being used as wicks for second development. It was also found that satisfactory two-dimensional chromatograms were obtained by using *n*-butanol-acetic acid-water mixture as first solvent, followed by pyridine water as the second solvent. The details are given below:

The position of the band of a particular amino acid group separated on the chromatogram run with *n*-butanol-acetic acid-water mixture was located by cutting out two small sectors on either side of a sufficiently big sector and spraying these with ninhydrin. These sprayed sectors were then replaced in their original positions and the area of the particular group of amino acid was traced with a pencil, keeping the ninhydrin stained ones as guide sectors. The area of the band was cut out, rolled in the form of a wick, one end of which was cut in the form of a brush and inserted into a hole made at the centre of another circular filter-paper. As usual the chromatogram was run using pyridine-water (80:20 v/v) as solvent mixture. In this solvent all the groups of overlapping amino acids separated into distinct individual circular bands (Figs. 1 and 2).

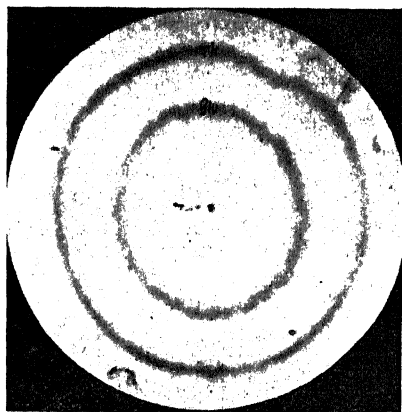


FIG. 1. Chromatogram showing the separation of glutamic acid and threonine which overlap and occur as single band in butanol acetic acid solvent.

For quantitative estimation, the bands relating to the overlapping amino acids were cut out. The amino acids were eluted by chromatographic elution and spotted on the circumference of a circle drawn at the centre of another

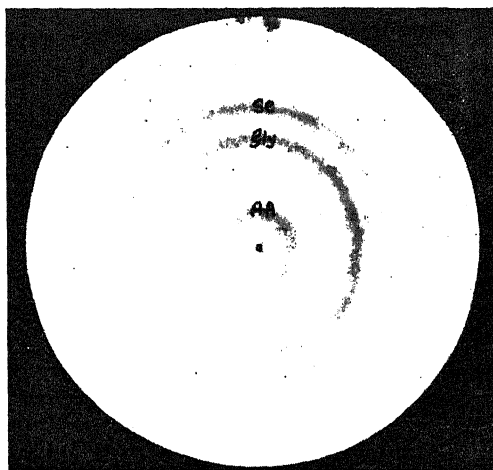


FIG. 2. Chromatogram showing the separation of aspartic acid, glycine and serine from each other, which overlap and occur as single band in butanol-acetic acid solvent.

filter-paper. Standard mixture of varying concentration of amino acids were also spotted on either side of the test spot and the chromatogram was developed with pyridine-water solvent. The bands separated on the paper after spraying with ninhydrin were cut out and the ninhydrin colour after elution with alcohol was estimated quantitatively according to the procedure described by Giri *et al.*² The results of a typical experiment carried out on the separation and quantitative estimation of a mixture of the overlapping amino acids containing 10 μ g. of each amino acid, are presented in the following table.

| Amino acids | Microgram of amino acids estimated after separation on the chromatogram |
|---------------|-------------------------------------------------------------------------|
| Aspartic acid | 9.6 |
| Glutamic acid | 9.7 |
| Glycine | 10.0 |
| Serine | 9.4 |
| Threonine | 9.5 |

The results indicate that the method is reasonably accurate for quantitative estimations.

Further work on the quantitative analysis of all the amino acids present in protein hydroly-

sates by the application of this technique is in progress. Full details of this investigation will be published in the *Journal of the Indian Institute of Science*.

Dept. of Biochemistry, K. V. GIRI.
Indian Institute of Science, N. A. N. RAO.
Bangalore-3,
February 18, 1953.

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A RAPID METHOD FOR THE DETECTION OF SMALL AMOUNTS OF CHICORY IN COFFEE

CHICORY is widely used in admixture with coffee and its detection in routine analysis of this beverage is important. When the amount of chicory in coffee exceeds about 15 per cent., determination of "water-soluble extracts" along with microscopical tests usually helps in its detection. When, however, the percentage is less than 15, these tests are often inconclusive. A chemical test was, therefore, developed which would detect small amounts of chicory with certainty. Chicory contains inulin hydrolysis of which gives levulose,¹ while pure coffee contains dextrose only. The test which has been developed is based on this fact.

The detection of chicory can be conveniently combined with the determination of the "water-soluble extracts". 50 ml. of the highly coloured extract from the "water-soluble extracts" determination (2.0 per cent. coffee extract) are treated in cold with 3 ml. of 10 per cent. aqueous solution of lead acetate, shaken thoroughly and filtered after a while. At this stage the filtrate has a slight yellow tinge. To 5 ml. of the clear filtrate in a test-tube are added 5 ml. of freshly prepared Seliwanoff reagent (0.05 g. resorcinol dissolved in 100 ml. of 50 per cent. HCl) followed by 1 ml. of conc. HCl. The mixture is gently boiled for a minute and then allowed to stand for 10 minutes. The characteristic red colour due to levulose develops if chicory is present in even as low an amount as 1 to 2 per cent. Pure coffee under these conditions does not develop any appreciable red colour, but only a yellow tinge. With 2.5 per cent. chicory, the red colour matches with 7-8 red units of the Lovibond Tintometer whereas pure coffee gives a tintometer reading of 0.5-1.0 red unit. Further work is proceed-

ing to give this test, if possible, quantitative character.

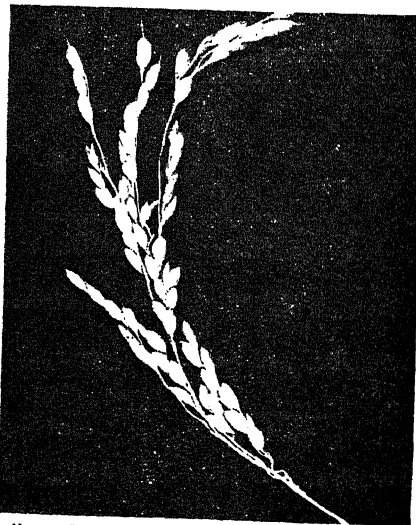
West Bengal Public
Health Lab., Calcutta,
November 22, 1952.

S. N. MITRA,
S. C. ROY.

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SOME ANOMALIES OCCURRING IN RICE, *ORYZA SATIVA* L.

IN a strain of rice plants, started from seeds obtained from Madagascar in 1948 through the courtesy of the "Inspection Générale de l'Agric-



culture" and designated by 0766 A, and which is undergoing genealogical selection ever

since 1949, one plant was found with panicles bearing some abnormal spikelets.

In some instances, but not very often, the spikelets appear ill-formed as a result of bearing the palea which is not fully developed; the caryopsis, on the other hand, in the absence of the protective wall offered by the palea, is either lacking or may develop quite abnormally, thus becoming longer and plump, conical in shape, more or less twisted and curved.

Sometimes, but less frequently, the atrophy of both inner glumes may take place, and they become reduced to two tiny scales. In such cases, the caryopsis always fails to develop.

Apart from the above-mentioned anomalies, empty glumes may occasionally be found which are larger in size than the normal ones.

Regarding other characteristics the plants may be considered as normal.

Some of the described aspects are shown in the above pictures.

MANUEL VIANNA E SILVA.

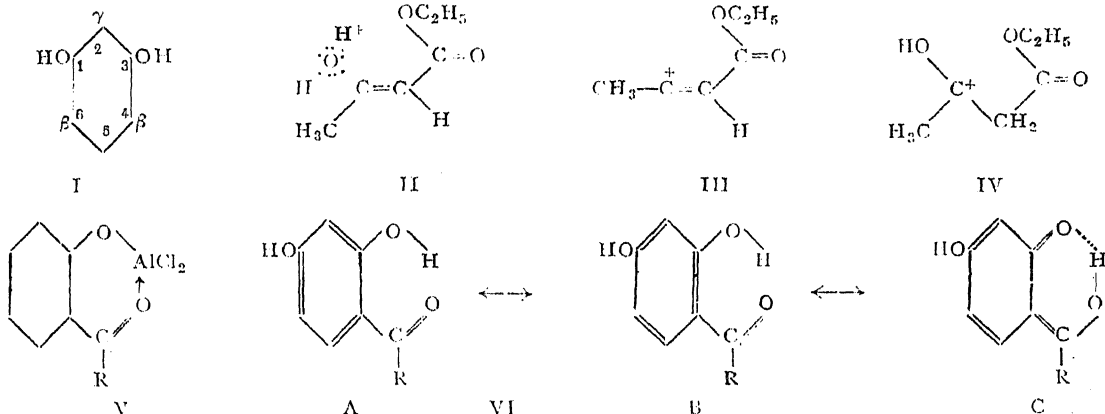
Estação Agronômica
Nacional Sacavém-Portugal,
December 5, 1952.

γ -SUBSTITUTION IN THE RESORCINOL NUCLEUS

IN a recent communication, Bafna and Shah¹ have discussed the mechanism of condensation of ethyl acetoacetate with particular reference to resorcinol derivatives having electron-attracting groups such as nitro or carboxyl in the β -position. The explanation put forward is based on two assumptions. Firstly, as the electron-attracting groups in the γ -position have

(see I). Secondly, they assume that ethyl acetoacetate in presence of an electrophilic reagent such as a proton (obtained from sulphuric acid) may give rise to (II), but when a stronger reagent such as anhydrous aluminium chloride is used, the carbonium ion (III) may be formed. Hence, they contend that during Pechmann condensation with the above resorcinol derivatives in the presence of anhydrous aluminium chloride, the carbonium ion (III) will react in the less deactivated γ -position giving 5-hydroxycoumarin derivatives, but in presence of sulphuric acid, due to steric requirements, the attack by the entity (II), at the γ -position would be inhibited (probably the authors mean retarded), and substitution would, therefore, occur predominantly at the β -position giving 7-hydroxycoumarins.

The authors, however, have not explained how the entity (II) will react with the nuclear carbon atom. If one accepts the usual explanations put forward for electrophilic reactions,² either the entity (II) by the loss of a molecule of water should form the carbonium ion (III), or the carbonium ion (IV) would be formed if the proton attaches to the carbonyl oxygen of ethyl acetoacetate. One of these two entities (III or IV) would then attack the nuclear carbon. The formation of one entity in the presence of sulphuric acid and another in the presence of aluminium chloride may be reasonable; but it is difficult to prove or disprove any explanation put forward on the basis of the geometry of these entities. However, the explanation advanced by these workers on the basis of the formation of entity (II) does not appear to be plausible.



less deactivating effect than when they are in the β -position, they suggest that the deactivation due to such β -substituents would be more at the other β -position than at the γ -position

Further, it is difficult to understand the logic of the argument by which they explain the difference in the reactivity of the β - and γ -positions. Even if one assumes the conclusions

arrived at by them to be correct, then during such electrophilic substitution reactions as nitration, bromination, etc., the above compounds should furnish γ -substituted products; while actually during nitration or bromination of resacetophenone³ or methyl β -resorcylate,⁴ β -substituted products are obtained. On the other hand, on Gattermann formylation⁵ or Friedel Crafts acylations⁶ in presence of anhydrous aluminium chloride, the substitution occurs predominantly, if not exclusively, in the γ -position. One has also to consider the observation of Baker⁷ that in resacetophenone derivatives, during Claisen and Fries rearrangements, the migration occurs preferentially to the γ -position when chelation exists but to the β -position if chelation is prevented, by masking the *ortho*-hydroxy group, and no trace of γ -isomer is reported. If as suggested by the authors, the degree of deactivation due to the electron-attracting groups, was the deciding factor in directing the substituents, the formation of β -isomers in the above cases becomes inexplicable. Hence this explanation is also not satisfactory.

The most important fact to be considered, before forwarding any explanation for this behaviour, is that in all the reactions studied, a free hydroxyl *ortho* to any chelate-forming group is an essential condition for γ -substitution; if the hydroxyl is masked, substitution occurs in the β -position. In view of this the earlier explanation of Baker,⁷ Shah and their co-workers⁸ that the γ -reactivity shown by these resorcinol derivatives is due to the existence of chelation (hydrogen bond formation) appears to be more plausible (though, as is now well known, the belief that chelation leads to absolute fixation of double bonds is erroneous⁹). Presumably, in the presence of protons the intramolecular hydrogen bond formation is weakened and during nitration and bromination the substitution occurs in the β -position, as generally in the case with other resorcinol derivatives. Strong chelate bonds are known to exist in the case of aluminium chloride (see V) and when such reagents are used, the substitution occurs predominantly in the γ -position.¹⁰ It is suggested that the combined contributions of structures B and C to the resonance hybrid, i.e., by those having a double bond between the positions 1 and 2, becomes larger, than that of structures such as A (see VI). This would result in comparative greater electron density at the γ -position and hence the substitution in that position.¹¹

The author is thankful to Dr. A. M. Mehta for helpful comments.

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October 28, 1952.

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A PRELIMINARY REPORT ON THE COLCHICINE-INDUCED TETRAPLOIDS OF *ANONA SQUAMOSA* L.*¹

THE fact that the autopolyploid fruits may attain larger size with an increase in the amount of flesh and that the number of seeds in them may be smaller,⁵ induced the author to embark on the induction of polyploidy in *Anona squamosa* L., in October, 1950.

Since there is a dispute about the diploid chromosome number of *Anona squamosa*, its somatic chromosome number was determined from a large number of root-tip cells, to be 14 and not 16 as reported by Bowden¹ (Fig. 1). Chromosome counts in the pollen-mother-cells which showed 7 clear bivalents in side view metaphase I and 2 groups of 7 chromosomes in metaphase II, confirmed the above observation. Further confirmation was obtained from the count of chromosomes of affected colchicined seedlings which showed 28 chromosomes and not 32 which should be expected if Bowden's report was correct. This observation is also in agreement with that of Kumar and Randive³ who reported the diploid chromosome number of *A. squamosa* to be 14 and not 16.

The author raised tetraploid *A. squamosa*, by colchicine treatment, a brief description of which is given below:

Seed Treatment: Seeds were germinated and treated with aqueous solution of colchicine on moist filter-papers placed in petri dishes. By a large number of trials it was found out that the seedlings on which the radicles had just emerged and in which the plumules were still inside the seeds responded most effectively to the action of colchicine. A large number of trials was then made with these seedlings which were completely immersed in aqueous solution of colchicine of various concentrations from 0.2 per cent. to 0.025 per cent. for various lengths of time from one hour to forty-eight hours. Polyploidy was successfully induced in those seedlings which were kept immersed in 0.2 per cent. for seven hours at 28° C.

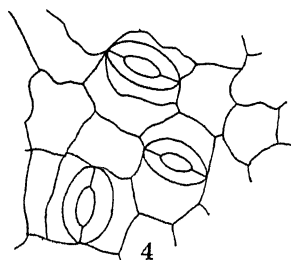
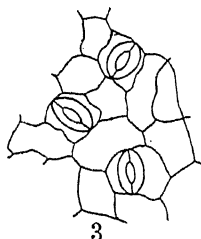
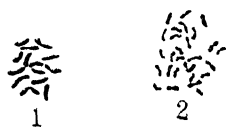


FIG. 1. Polar view of metaphase of mitosis showing 14 chromosomes in a root-tip cell, $\times 1,550$.

FIG. 2. Somatic chromosomes from a root-tip cell of tetraploid *A. squamosa*, $\times 600$.

FIGS. 3 and 4. Stomata of control and tetraploid plants, $\times 280$.

Chromosome counts in the root-tip cells showed 28 chromosomes (Fig. 2) in most of the cells. The seedlings which were removed to pots after the treatment, showed extremely stunted growth, accompanied by malformed leaves, in the first phase of their development. However, after a period of four to five weeks they recovered and have been growing quite

healthy (in the Botanical Garden, University of Dacca). The leaves of the tetraploids were found to be darker green in colour, thicker in texture, larger in size than the control.



FIG. 5. A twenty-month old plant with a young fruit in sight, $\times 1/20$ Natural size.

Some of these colchicined plants were seen to flower in last May, i.e., 1952, in twenty months' time and produce a few fruits (Fig. 5) while the control did not show any sign of blossom. Early flowering has also been recently reported in colchicine-induced tetraploid gooseberries (*Ribes nigrum*).⁵

Since the tetraploids, as a rule, show delayed flowering² than the diploids, this observation that reproduction is hastened in the colchicine-induced tetraploids of a woody species is of considerable interest and the possibility that other woody species may show the same effect is worth closer inspection.

Shoot-tip Treatment: Seeds were sown in the soil and when the shoots were seen to emerge out just above the soil, the tips were plunged into small vials containing different concentrations of colchicine from 0.2 per cent. to 0.025 per cent. for various lengths of time, from one hour to seven days. Out of a large number of treatments colchicine produced appreciable effects only on a few seedlings which were subjected to six hours' treatment in 0.2 per cent. while the rest of the seedlings either succumbed to the effect of colchicine or were unaffected by the treatment.

In three of the colchicine-affected plants, the leaves were found to be darker green in colour, thicker in texture and larger in size with thicker midribs and veins than the control. These external features which are usually the external signs of polyploidy⁴ led the author to believe that the above three plants were polyploids and an examination on the size of their stomata

(cf. Figs. 3 & 4), their frequency (see Table I) and the average size of the internal tissue of their leaves substantiated the belief that these plants had undergone polyploidy. (As the roots were not treated with colchicine chromosome counts from root-tip cells would not serve to indicate polyploidy).

In one colchicine-affected plant, a polyploid chimæra arose. It was interesting to note that the size of the polyploid leaves, in this case, was even smaller than those of the diploid branch, while in other characters, e.g., texture, colour, stomatal frequency, etc., there was no difference between this chimerical plant and other normal polyploids. The growth-rate of the polyploids and the polyploid branch of the chimerical plant is slower than the control.

TABLE I

| | Size of stomatal aperture | Size of guard cells | Number of stomata in the under-surface per sq. mm. |
|---------|---------------------------|-----------------------------|----------------------------------------------------|
| Treated | 22.2-18.5 × 2.7-1.8 | 39-33.3 × 15.7-11.1 | 129 |
| Control | 14.8-11.1 × 1.8-1.5 | 22.2-18.5 × 11.1-9.25 | 303 |

The author acknowledges his gratefulness to Professor S. C. Harland, University of Manchester, for kindly going through the manuscript and kind criticism.

Dept. of Botany,

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Manchester-13,

January 9, 1953.

* This piece of research work was carried out in the Dept. of Botany, University of Dacca, and partly financed by the Central Govt. of Pakistan.

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A MARINE SPECIES OF SLOW LACTOSE FERMENTING BACTERIUM

IN our studies on the bacterial flora of marine fish, we have come across a strain of slow lactose fermenter from mackerel caught off Tellicherry. Initial isolation was made on ZoBell's agar. This strain grows well on sea-water media but fails to grow on fresh-water media and in milk to which salt is not added. Thus it is typically a marine species. Even a one-year-old culture after sub-culturing half-a-dozen times, failed to grow in fresh-water media. If it were a terrigenous or fresh-water form, which had acclimatized itself to sea-water, it must survive when carried back to the fresh-water environment.¹ The strain described here, did not grow in fresh-water media and is essentially "marine" in origin. In contrast to this we have isolated two strains of slow lactose fermenters from the slime of mackerels, which grow well on fresh-water media also. Since a marine bacterium producing gas from lactose has not so far been described, a full description of our strain is given below:—

| | DESCRIPTION |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sea-water ² agar colonies | Bluish grey, translucent, flat, entire |
| Sea-water agar slant | Translucent gray, smooth, becomes adherent and brittle later |
| Morphology | Rods, actively motile, small, single and pairs, 0.8×1.2 γ gram negative, nonspore-forming |
| Sea-water broth | Turbidity and thick cushion-like pellicle at top appearing like a layer of paraffin wax |
| Fresh-water broth | No growth |
| Gelatin | Not liquefied |
| Nitrates | Reduced to nitrites |
| Indole | Not produced |
| 'Purple' milk | No change |
| H ₂ S | Not produced |
| Carbohydrates, etc. | Acid and small amount of gas from dextrose, sucrose, maltose and mannitol in 24 to 48 hours. No pellicle formed. Very slight acid formation and some gas from lactose in 9 days. Pellicle formed. Glycerol was not fermented but pellicle (growth) formed |
| Starch | Hydrolysed |
| Methyl Red | Positive; Voges Proskauer test, negative |
| Citrate | Not utilized. Urea; Not decomposed |
| V.R.B. agar | No growth |
| Fresh-water agar | No growth |
| Tolerates 10% NaCl. | |

Source : Gills of mackerels, off Tellicherry.

Note.—All media except purple milk and fresh-water media, were made up with autoclaved sea-water,

According to Bergey's Manual² this may be classified as *Paracolobactrum coliformæ* but in view of its specific marine habitat, it may be designated as *P. coliformæ* var. *marinum*.

Further interest lies in the fact that *Paracolobactrum* species were isolated from cases of gastroenteritis.³ We have described 9 strains of *Paracolobactrum* (under communication) from fresh-water fish, but the one described here differs from them. A full account of the types of bacteria in marine fish will be published elsewhere.

Our thanks are due to the Director of Fisheries, Madras, for permission to publish this note.

Fisheries Tech. Station, R. VENKATARAMAN.
Kozhikode-1, A. SREENIVASAN.
January 2, 1953.

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A TECHNIQUE FOR MASS-BREEDING OF APANTELES N. SP. (BRACONIDAE HYMENOPTERA)

Apanteles n. sp. is an internal larval parasite of the pink boll-worm, *Platyedra* (*Pectinophora*) *gossypiella* Saunders on cotton, and appears to be a very efficient and potential parasite of the pink boll-worm in the important cotton-growing tracts of India. The adults were at first collected from the environs of New Delhi by one of the authors (G. W. A.) and subsequently recovered from the following places: Delhi, Karnal, Ludhiana, Hansi, Bulandshahr, Kanpur, Raya, Nagpur, Akola, Jalgaon, Yeothmal, Surat and Coimbatore.

The technique of mass-breeding this parasite has been worked out in the parasite laboratory of the Division of Entomology, Indian Agricultural Research Institute, New Delhi. Eggs of *Corcyra cephalonica* Stainton were scattered over a disk of moist absorbent paper and ex-

posed to the parasites in a cloth-covered glass cage (Fig. 1), the floor of which was covered

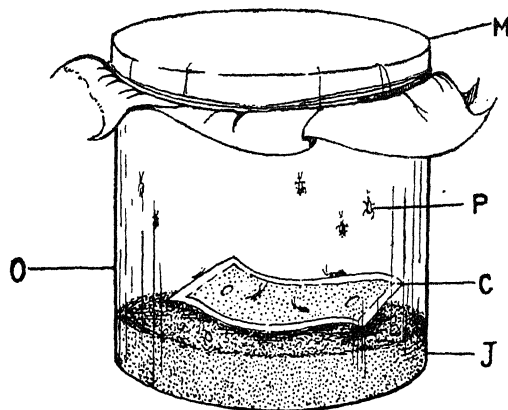


FIG. 1

O : Oviposition cages, P : Adult parasites, C : *Corcyra cephalonica* eggs pasted on the card, J : Crushed jowar, M : Muslin covering.

by a thin layer (about $\frac{1}{2}$ " in height) of crushed jowar. The parasites were fed on honey-sugar mixture and the oviposition cage left undisturbed for about 8 days after which the jowar containing the parasitised host larvæ transferred to a petri-dish. Adult parasites emerge from this culture about 20 days after oviposition. Only one cocoon has been observed on one host. Sex-ratio appears to be approximately 2 : 1 females predominating. The entire breeding was conducted at 25° C. and 75% R.H. Detailed studies as regards biology and field behaviour are in progress.

The success that has attended our efforts in breeding this new parasite on a mass scale on an easily available laboratory host augurs well for the biological control of a very serious cosmopolitan pest of cotton distributed throughout the cotton-growing regions of the world.

Division of Entomology, E. S. NARAYANAN.
Indian Agri. Res. Inst., G. W. ANGALET.
New Delhi, B. R. SUBBA RAO.
January 10, 1953. G. I. D'SOUZA.

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A. V. TELANG,
Secretary,
Current Science Association.

REVIEWS

Thermal Diffusion in Gases. By K. E. Grew and T. L. Ibbs. (Published by Cambridge University Press), 1952. Pp. xi + 143.

This is one of the latest monographs on physics, published by the Cambridge University Press and is decidedly more substantial and comprehensive than the volumes of the older series. Being the first book devoted wholly to the important subject of thermal diffusion, it will be widely welcomed by research workers and students alike.

Ever since the discovery of thermal diffusion by Chapman and Enskog, a large volume of experimental work has been done in which the contribution of the authors—Dr. Ibbs and Dr. Grew has been considerable. The authors have the pleasant task of presenting their own contribution along with those of others, which they have succeeded in doing with great clarity and insight in this small monograph. The first two chapters conveniently summarize the theory of thermal diffusion based closely on that given by Chapman and Cowling in 'The Mathematical Theory of Non-Uniform Gases', the aim being to familiarize the reader with the physical ideas rather than the complicated mathematical theory. The next two chapters give an account of the experimental methods and results obtained thereby. An attempt to correlate these results with theory has been done in Chapter V. The closing chapters of the book deal with the diffusion thermo-effect and the thermal diffusion in liquids.

The principal aim of the authors is to present the experimental work on thermal diffusion of which the major portion has been carried out during the last decade. The authors have succeeded in giving a clear and coherent account of the various experimental methods, the experimental results and the interpretation of these results in terms of the theory, and the molecular force models. The book is essentially written for the experimenter and will be extremely valuable to those embarking upon a course of experimental research in this field, as well as to non-specialists. The research worker must, however, supplement it by a much greater knowledge of the rigorous mathematical theory to be found in Chapman and Cowling's book. The reviewer feels that the value of the book would be enhanced by a more detailed account of the mathematical theory and by giving

a treatment of thermal diffusion from the standpoint of the thermo-dynamics of irreversible processes.

The utility of the book has been greatly increased by the large number of references and by the exhaustive compilation of the experimental data on thermal diffusion, given at the end. Considering the book as a whole, the reviewer has no hesitation in recommending it to all those who want to study the subject for the first time, and, especially to those interested in the practical applications of thermal diffusion.

B. N. S.

Designing by Photo-Elasticity. By R. B. Heywood. (Chapman & Hall Ltd., London), 1952. Pp. 414. Figs. 65 S.

Dr. Heywood's book fills a long-felt gap in the field of designing and should be read by all connected with the fields of photo-elasticity and design. The science of stress analysis is being increasingly applied to the problem of designing parts which are light and yet of sufficient strength. This book draws attention to the elegant method of stress analysis by photo-elasticity and its application to the problems of design.

The first part of the book represents an excellent summary of the theory of photo-elasticity and takes up the following topics.

Chapter 1.—Behaviour of Light in Polariscopes. This lays the basic foundations of photo-elasticity by dealing with the principles and the set-up of polariscopes. In particular, it contains a short description of the diffuse light polariscopes, its merits and demerits. Chapter 2.—Photo-elastic Materials, and Chapter 3.—Models, Their Preparation and Testing. Photo-elastic materials, their properties, the methods of making and loading the model are dealt with in a concise and yet clear manner. Chapter 4.—Model Stresses Applied to Prototypes. Chapter 5.—Frozen Stress Technique for Three-Dimensional Analysis. This chapter describes the freezing technique employed in the three-dimensional analysis, slicing of the model and the examination of the slice and interpretation of the frozen stress pattern by the double slice and the oblique incidence methods. Materials suitable for the three-dimensional analysis and their properties and the application of the frozen

stress technique for specific problems are also dealt with.

The second part of the book deals at length with "Stress Concentration", the factor of increasing importance in the problems of design. Stress concentration factors potentially useful for direct application to design problems have been collected and are presented in a form convenient for ready reference.

Chapters 6, 7 and 8 present an excellent and up-to-date collection of data on the stress concentration factors in particular notches, screw threads, bolts and nuts and at holes for different types of structural numbers.

Chapter 9.—Improvement of Designs. This represents an inquiry into the methods by which the design of a part may be improved and gives an interesting exposition of the proper design of fillet shapes and their effects on the design of parts.

Chapter 10.—The Application of Stress Concentration Factors.

An extensive list of references classified according to the subject is given and will be found very useful by readers.

C. N. LAKSHMINARAYANA.

Solvents. By T. H. Durrans. 6th Edition. (Chapman & Hall), 1950. Price 21 sh.

This is the sixth edition of a well-known work. The subject is dealt in two parts, the first one dealing with fundamental aspects while the second part deals with individual members. Though the title leads one to expect a comprehensive account, the treatment is confined purely to solvents of use in the lacquer industry. The theoretical treatment is of the most general kind which is inadequate in a specialised monograph. The second and larger part contains a good deal of useful information on the characteristics of the different organic solvents divided according to their characteristic functional groups. The chapters on inflammability of solvents and their toxicity should prove useful to those handling these organic chemicals. The two appendices increase the value of the volume and the price is moderate. The volume can be recommended both to workers in the lacquer industry and to the general laboratory.

Superconductivity. By D. Shoenberg. 2nd Edition. (Cambridge Monographs on Physics, University Press), 1952. Pp. 256. Price 30 sh.

This book is an enlarged edition of Shoenberg's *Superconductivity* which appeared as one of the Cambridge Physical Tracts in 1938. The

publication of the present volume is to be welcomed in view of the many recent advances in our "knowledge of the facts of superconductivity and in our understanding them" and also due to the lack of any other up-to-date account of the subject.

Although there have been many theoretical advances in the explanation of the behaviour of superconductors, the basic ideas necessary for putting forward a complete theory of the phenomenon have not all been clearly understood. This fact has, in the past, stimulated a variety of investigations conducted with a view to throw light on the nature of superconductivity. Professor Shoenberg has succeeded admirably in the task of making a comprehensive and ordered survey of these against the appropriate theoretical background. After a short introductory chapter, the author describes in detail the magnetic and thermodynamic properties of superconductors. Sections on thermal conductivity and thermo-electricity, not contained in the earlier edition, are introduced here. Chapters IV and V contain an account of our knowledge of the intermediate state and of the various methods by which the depth of penetration of a magnetic field in superconductors is investigated. The phenomenological theories of superconductivity and some recent attempts to put forward a more fundamental theory are described in the last chapter. Tables of numerical data are appended to the text. The extensive bibliography at the end of the book contains reference to more than 400 publications and includes the most recent work on the subject.

The author of the book has been actively engaged on research in this field or on allied fields of study for the last eighteen years. For about ten years he has also been the Director of the Royal Society Mond Laboratory at Cambridge, U.K., which is at present one of the leading centres for low temperature research. The book is, therefore, to be warmly recommended to all advanced students of physics—needless to mention that it will prove to be an indispensable guide to the research workers.

K. G. RAMANATHAN.

Pre-Stressed Concrete. By Kurt Billig. (Mc-Millan & Co., Ltd., London, W.C.2), 1953. Pp. x + 470. Price 36 sh. net.

Pre-stressed concrete is a recent off-shoot of reinforced concrete, which is highly elastic, has a small dead weight, and saves up to 85 per cent. in the weight of steel as compared with reinforced concrete.

There are very few text-books on this subject though many articles pertaining to it have appeared during the last five years in Civil Engineering magazines. In India, pre-stressed work started only two years back. The publication of this book, which gives in concentrated form all the information available on the subject is, therefore, very timely. Engineers specialising in reinforced concrete construction have to familiarise themselves with this newer form of construction as this will quickly supersede the older methods. They will find this book very useful.

The book is in three parts: the first deals with general data and fundamentals; the second, with the design of pre-stressed concrete structures; and the third one with design problems and includes a number of numerical examples.

The author has also proposed a draft code of practice which has been given in the end as an Appendix.

A recent development which seems to offer considerable attractiveness is the possibility of using bars instead of wires. Ultimately, the choice among the various kinds of reinforcement and the several methods of fabrication will be based on simplicity of construction methods and cost.

The following topics could have been further elucidated or included in the book to make it more exhaustive. The fatigue strength of pre-stressed concrete appears to be almost entirely related to the bond strength under repeated loading and the strength of the anchorage under such loading. This anchoring of the ends of reinforcement inevitably produces stress concentrations. Tests of the adequacy of anchorages will have to be made where it is proposed to depend entirely on the anchorages to develop the stress in the reinforcement. The fire resistance of pre-stressed concrete depends both on the loss due to changes in length and changes in physical properties caused to the wires. A secondary factor should also be considered, which is the possible change in the strength of the anchorage as it is heated. Design of pre-stressed reinforcement in structures subjected to reversal of loading may be included in the third part. So also the problem which arises when a structure is subjected to blast deserves close study. The problem of designing pre-stressed concrete for continuity has been discussed thoroughly by the author.

The draft code suggested by the author should prove useful to the Joint Committee of the American Society of Civil Engineers and the American Concrete Institute recently con-

stituted to draw up a general specification. The addition of an index to the book would have added to its usefulness. N. S. GOVINDA RAO.

Ink and Paper in the Printing Process. By Andries Voet. (Published by Interscience Publishers, Inc., New York), 1952. Pp. xii + 213. Price \$5.90.

The volume under review is essentially an introduction to the physics and chemistry of printing ink and its reaction with paper. Probably this is the only book of its kind in which an attempt has been made to present the subject in proper scientific perspective. While it is primarily intended for "the more experienced graphic art student with basic understanding of science", one feels that the book may be read with interest and profit by any student of physical science, inasmuch as it covers a field in which the basic principles of physics and chemistry find such fruitful application.

Such topics as colour, gloss and dispersion of ink, on which standard treatises are available, have been rightly omitted from the purview of this volume. It is divided into two sections entitled "Ink and Press", and "Ink and Paper", which are again subdivided into sixteen short chapters.

Some of the earlier chapters in Part I deal exclusively with such basic topics as viscosity, flow of dispersions, thixotropy, etc. The remaining chapters contain a discussion of the flow characteristics of ink and the separation of ink films. The use of specialised types of instruments like the inkometer, tackmeter, spreadometer, etc., is fully described with adequate theoretical background.

The second part is devoted to various topics such as the characteristics of discontinuous reproduction, halftone printing, contrast and coverage of ink, uniformity of ink films, penetration of ink into paper, ink transfer and such printing defects as "print through" "pricking of paper" and offset. The two well written chapters on physical and chemical drying of ink deal exhaustively with a subject of wide interest to many branches of technology.

A. P. MADHAVAN NAIR.

Annual Review of Biochemistry. Vol. 21. (Publisher: Annual Reviews, Inc., Stanford), 1952. Pp. 781. Price \$6.00.

With the publication of this volume, the twenty-first in the series, the *Annual Review of Biochemistry* may be said to have come of age, although the reputation for its excellence was well established a long time ago. In spite of

the fact that new Annual Reviews have been published in recent years, in closely related fields, some of which have absorbed a considerable portion of the subject-matter of biochemistry in its broadest sense, the present volume is over 750 pages of small print and has not diminished either in size or in wealth of material. The volume consists of twenty-three articles written by scientists, who can claim eminence in their respective fields of biochemical investigation. Even though some of the articles are disproportionately long, they have been written in such an elegant and comprehensive manner that they deserve very careful study.

As in previous numbers, the articles on proteolytic enzymes, non-oxidative, non-proteolytic enzymes and biological oxidations have been presented in this volume in the very beginning, and they cover very well the researches carried out during the year under review. The topics on the chemistry of various classes of substances such as carbohydrates, carotenoids, lipids, steroids, non-steroids, hormones, amino acids, nucleic acids, with a special article on the chemistry of muscle, have been presented next. Similarly, the research work carried out on the metabolism of the above-named substances have also been reviewed in subsequent articles. There are, further, three topics on fat-soluble vitamins, water-soluble vitamins and general nutrition respectively. The reviews on chromatography and on comparative biochemistry, as well as on the biochemistry of neoplastic tissue and antibiotics, may be considered in the nature of special articles, as they deal with the rapid advances which have taken place in these particular fields during the year under review.

There can be no doubt that all the articles constitute a judicious appraisal of the year's research work in all the different branches of biochemistry and nutrition. They have all been written as critically and, at the same time, as comprehensively as possible. The present volume of the *Annual Review* has maintained the high standard of the earlier volumes of this series and should prove indispensable to all those who are interested both in the research and the teaching of biochemistry and nutrition.

P. S. SARMA.

Proceedings of the Symposium on Indian Oils and Fats and Their Utilization. (National Chemical Laboratory of India). Price Re. 1.

This is a record of the discussion of the various problems for a fuller utilization of the oil and fat resources of the country. The dis-

cussions were held under the following major heads, the figures under brackets showing the number of papers read under each head: (a) oilseeds and vegetable oils (11); (b) oil extractions (9); (c) soap and glycerine (5); (d) hydrogenation of oils (4); (e) fish oils (1); (f) castor oil, drying oils, paints and varnishes (9); (g) analytical and other miscellaneous papers (11). It is thus seen that all aspects of the problem have been considered. A perusal of the publication shows that those who contributed papers and those who took part in the discussions, have given considerable thought to the subjects and, as a result, one is able to gain an authoritative and authentic picture.

There are many trees in Indian forests whose full economic utilization to supplement the oilseed supply is a matter of great urgency. The first paper deals with the forest oilseed wealth of Bombay State. The refining and utilization of the natural resources are adequately dealt with. Problems relating to oil extraction, hydrogenation of oil, soap manufacture and shark liver oil industry have also been well discussed. The last section deals with various analytical methods. The publication deserves earnest perusal by all persons who are interested in the industries relating to fats and oils.

K. N. M.

Practical Plant Pathology. By M. N. Kamat. (Prakash Publishing House, Poona), 1953. Pp. xiii + 200. Price not given.

The author has undertaken a commendable task in bringing out a book on practical plant pathology to meet the requirements of students in Agricultural Colleges and University Laboratories in India. The plan of the book is well laid out and the get-up is good. Numerous plates have been provided to help the student in his studies.

It appears that proof-reading has not been carried out properly as is evidenced by numerous spelling mistakes. The legends and figures in some plates are also not correct (e.g., Plate 33, Fig. 6; Plate 36, Fig. 11).

There are several factual inaccuracies which should have been avoided, e.g., page 33, item 27: "withertip" is given as an example of canker; page 55: downy mildews are described as "typically aquatic"; page 79: smuts and bunts are stated to be "facultative parasites"; page 81: infection type of long smut of sorghum is mentioned as "unknown"—this has been described by different authors; page 44: late blight of potatoes is stated to be destructive "on the Nilgiris", whereas this disease is unknown

there; page 135: the heading is given as *mycelia sterila* but included in it are *Polyporus*, etc.

In the chapter on principles of plant disease control, the measures advocated are not the best in several instances. This chapter is in need of thorough revision.

On going through the book, one is left with the impression that it has been prepared in haste, without strict verification of the statements made. The author would do well to revise the book and bring out a corrected edition.

T. S. R.

Books Received

Applied Electricity. By H. Cotton. 2nd Edition. (Cleaver Hume Press Ltd.), 1953. Pp. xii + 482. Price 18 sh. 6d.

The Wealth of India. Edited by B. N. Sastri. (C.S.I.R. Publications Division), 1953. Pp. xx + 236 + xxix. Price Rs. 18.

Crime Investigation. By Paul L. Kirk. (Interscience Publishers, N.Y.), 1953. Pp. 806. Price \$ 10.00.

The Chemistry and Physiology of the Nucleus. Edited by V. T. Bowen. (Academic Press, Inc.), 1952. Pp. ix + 402. Price \$ 7.00.

Signal, Noise and Resolution in Nuclear Counter Amplifiers. By A. B. Gillespie. (Pergamon Press, Ltd.), 1953. Pp. ix + 155. Price 21 sh.

The Elements of Nuclear Reactor Theory. By Samuel Glasstone and Milton C. Edlund. (MacMillan & Co.), 1953. Pp. 416. Price 35 sh.

Dissociation Energies and Spectra of Diatomic Molecules. By A. G. Gaydon. 2nd Edition. (Chapman & Hall), 1953. Pp. xiii + 261. Price 35 sh. net.

Ferrous Analysis (Modern Practice & Theory). By E. C. Pigott. 2nd Edition. (Chapman & Hall), 1953. Pp. xxvii + 690. Price 84 sh. net.

BCG Vaccination. (World Health Organization), 1953. Pp. 307. Price \$ 3.00.

The Comets and Their Origin. By R. A. Lytleton. (Cambridge University Press), 1953. Pp. 173. Price 25 sh.

Die-Gasturbine. By Von J. Kruschik. (Wien Springer Verlag), 1952. Pp. xi + 469. Price \$ 15.00.

Radiations and Living Cells. By F. G. Spear. (Chapman & Hall), 1953. Pp. xii + 222. Price 18 sh. net.

Historical Metrology. By A. E. Berriman. (London J. M. Dent & Sons. Ltd., New York, E. P. Dutton & Co.), 1953. Pp. xv + 224. Price 16 sh.

SCIENCE NOTES AND NEWS

Endeavour Prizes

The Imperial Chemical Industries, Limited, Publishers of the scientific review, *Endeavour*, have offered the sum of 100 guineas to be awarded as prizes for essays submitted on the following subjects: Radio-Astronomy; Colour and Chemistry; Biology in World Affairs; Science and Safety in Transport; Science and Art; Scientific Contributions to Medicine; Scientific Societies and Their Role; Power and Civilization. The competition is restricted to those who are under 25 years of age on 1st June 1953.

The essays, which must be in English and typewritten, should not exceed 4,000 words in length and only one entry is permitted from each competitor. In judging the results, special attention will be paid to the originality of approach to the subject, and great importance will be attached to literary style.

Entries should reach the Assistant Secretary,

British Association for the Advancement of Science, Burlington House, Piccadilly, London, W.1, before 1st June 1953.

New Issue of *British Pharmacopoeia*

The first edition of the *British Pharmacopoeia* appeared in 1864 under a Section of the Medical Act, 1858, which provided for the original publication and periodical re-publication. On 2nd March 1953, appeared the eighth *British Pharmacopoeia*, now under the official sanction of the Medical Act, 1950, and for the first time published by the Pharmaceutical Press on behalf of the General Medical Council (Price 50 sh.)

The *British Pharmacopoeia*, 1953, is a complete revision. Each drug is discussed in a monograph covering such matters as chemical formula, description, solubility, methods of identification, assay and dosage in the various preparations available. For the first time, Latin

has been abandoned in the main title of the monographs (nearly 750 in all) and English is used with Latin as a sub-title. Doses are expressed in the metric system only, except for those substances and preparations commonly used or prescribed in the Imperial system. A series of 25 appendices describes standards for materials used in official tests, and descriptions of chemical, physiological and biological assay procedures. The new *British Pharmacopœia* becomes official from September 1, 1953.

Twenty-Sixth International Congress of Industrial Chemistry

The Twenty-sixth International Congress of Industrial Chemistry will be held in Paris during 21st to 27th June 1953. Sectional meetings will be held on Chemical Analysis; Minerals; Ceramics; Resin; Rubber; Cellulose; Paper; and Textiles, etc. Further details can be had from the Secretary, XXVI Congress International De Chimie Industrielle, 28, rue Saint-Dominique, Paris VII.

Sixth International Congress of Microbiology

The Sixth International Congress of Microbiology will be held in Rome during September 6th to 12th of this year. In addition to plenary sessions and meetings under the various sections, symposia on the following subjects have been planned to be held: Bacterial Cytology; Microbial Metabolism; Nutrition and Growth Factors; Growth Inhibitors and Chemotherapy; Morphology, Biology and Systematics of the Actinomycetales; and Host-Virus Interactions. For fuller particulars, please write to: G. Sanarelli, Segreteria del Congresso, Istituto di Igiene, Citta Universitaria, Rome, Italy.

Antibiotics from Soil, Plants and Other Sources

A symposium on "Anti-Bacterial Substances from Soil, Plants and Other Sources", was held on 26th and 27th March 1953 in Bombay under the auspices of the Pharmaceuticals and Drugs Committee of the Council of Scientific and Industrial Research. In the absence of Col. R. N. Chopra, Chairman of the Committee, Dr. B. Mukerji, Director, Central Drug Research Institute and Member of the Pharmaceuticals and Drugs Committee, presided.

Twenty-one papers dealing with the isolation, testing, standardization, therapeutic uses and mode of action of anti-bacterial substances from various sources were presented at the symposium. It is proposed to publish the proceedings of the symposium in the form of a brochure consisting of abstracts of various papers and discussions thereon.

Effects of Tannage on the Properties of Leather

Specific information regarding the effects of different tannage on the properties of leather has recently been obtained by Dr. J. R. Kanagy and associates of the National Bureau of Standards, U.S.A. Leathers tanned with chrome alone were compared with those tanned first with chrome and then re-tanned with vegetable tannins. The results in general indicate that each of the two types of leather has certain definite advantages, and that choice of tannage should depend largely on the properties desired in the finished leather.

Both methods of tanning are widely employed in the leather industry. In general, the more rapid chrome-tanning is now chiefly used for lighter leathers, such as calfskin shoe uppers and kidskins for gloves, while the two-step process is used for heavier leathers such as soles, belting and heavy uppers.

The test results showed that the vegetable tannins tend to decrease water resistance, reduce strength and increase thickness. However, on the whole, the properties produced by use of the vegetable tannins tend to make the leather more comfortable for shoes and to increase cutting value (percentage of useable hide).

Calorie and Body-Weight

Between 1943 and 1949, the Ministry of Food, U.K., regularly made large-scale investigations of the calorie value of food reaching the consumer and the changes in average body-weight. Subjects of the investigations were housewives and men and women employed in light industries. Every year, 3,000 to 4,500 people were put on the scales and 20,000 to 30,000 furnished information about food eaten and the state of larder stocks.

Graphs plotted from this information showed a striking resemblance. During the last two years of the war, there was an increase of about 140 calories per head per day in the foods consumed, and men put on about 1½ lb. in weight, women 3 lb. In the first two post-war years, the daily calorie intake fell by 120 and men lost 1 lb., women ½ lb.; from 1947 to 1949 the energy value of the diet rose by 120 calories and men's body weight rose by 2 lb. and women's by 3 lb.

Commenting on the investigations, the Ministry of Food take the view that on certain broad assumptions, changes in body-weight can be taken as an index of the adequacy of food supplies and of the state of peoples' health.

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RECENT DEVELOPMENTS IN THE METHODS OF RICE CULTIVATION IN INDIA

INDIA grows rice in 75 million acres out of the world total of 233 million acres and the production is 32 million tons of rough rice or paddy against a world total of 150 million tons. Among the largest rice-growing areas, Japan records the highest yield of nearly 3,200 lb. with an acreage of nearly 7.8 million acres. In China with an acreage of 47 million acres, the yield is 2,200 lb. while in India the yield is 913 lb.

RICE IMPROVEMENT IN INDIA

The improvement work in rice was first started in India in the second decade of this century in Madras and Bengal and was followed in other States much later and the Indian Council of Agricultural Research from its inception in 1929 promoted this work by giving financial aid to the various rice schemes sponsored by the States. The improvement work consisted mainly in the evolution of higher yielding varieties by the methods of selection

and hybridization. There are now nearly 284 improved varieties suitable to the different climatic and soil conditions in India. These varieties on an average give about 10 per cent. more yield than the local varieties. Side by side with the improvement of varieties by breeding, extensive manurial experiments were also conducted in various rice-growing States. Though the investigations on the manurial requirements of rice crop have not been carried out on the same scale as in Japan, the results so far obtained lead to the general conclusion that the application of organic manures like green manure at the rate of 4,000-5,000 lb. per acre supplemented by artificials like ammonium sulphate and superphosphate 150 lb. each, give responses to the extent of 15-40 per cent. or more, depending upon the soil condition. In the field of experiments regarding improvement in cultural practices the very first recommenda-

tion of the Madras Department of Agriculture as early as 1918 is the thin sowing of paddy nurseries and economic planting. It was shown by experiments that thin sowing not only increased the yield but also contributed to a considerable saving of seed. The yields from various Rice Experimental Farms in India which have adopted these methods range from 2,000-4,000 lb. which is nearly two to four times the average yield in India. On the other hand, the average yield figure in India has not increased so far due to various reasons.

During the Conference of Agricultural Scientists held in New Delhi in 1949, the problem of low yield obtained in crops in India was discussed fully and it was pointed out that the most important contributing cause is the delay in cultural operations. There is generally deficiency of available bullock power and it was recommended that in areas with assured irrigation, transplanting should be done as this alone gives 20 per cent. more yield than when sown broadcast. It was also recommended that provision must be made in every locality for sufficient number of nurseries for raising seedlings of rice and their supply at transplanting time. The advice regarding the thin sowing of nursery should be imparted to cultivators. All effective methods so far known regarding cultural operations such as early ploughing, timely sowing and planting, irrigation and weeding should be brought home to the cultivator by oral and visual propaganda and through leaflets. Prizes and certificates should be given to the best farmers who produce good crops.

The encouragement given by the Government recently in the shape of substantial awards has resulted in some farmers producing record yield of 8,000-12,000 lb. per acre. There is, therefore, great scope for increasing the rice yields by adopting good cultivation practices, judicious manuring of fields with organic and inorganic fertilizers and the extensive use of the good seed of improved varieties. These experimental results have not been extensively utilised by the cultivators due to the want of adequate extension machinery in India.

RICE IN JAPAN

The attention of the Ministry was directed to the important features of rice cultivation in Japan which has recorded an average yield of 3,500 lb. per acre and an article on 'Features of Rice Work in Japan and How They Differ from Those in India' by Ramiah and Vachhani was contributed to the *Indian Farming* in 1950. This article aroused a lot of interest and a number of enquiries regarding this was answered by the

Central Rice Research Institute. Since its publication, it is gathered that this article had been reproduced in some journals in different States of India. In November 1952, issue of the *Farmer* issued by the Director of Publicity, Government of Bombay, an article on "Paddy Growing in the New Way" dealt with the results of work done in 1951 at the Agricultural School Farm at Kosabad near Gholwad and also at the Kora Gram Udyogic Kendra at Borivili, near Bombay by following "the modified Japanese methods" to suit the local conditions. The Minister for Agriculture, Government of India, in his broadcast from the All-India Radio, Delhi, in January 1953, gave the details of the Japanese methods of rice cultivation which has given 4,000-6,000 lb. paddy per acre in the two farms mentioned above in Bombay and a lot of interest among the public and the Press has been roused about this new Japanese way of cultivation in rice. This enthusiasm, it is hoped, augurs well for the future of rice cultivation in this country.

The essential features of the Japanese method of cultivation are :

(1) *Seed-bed.*—Good nursery management for the production of strong and healthy seedlings. This is effected by bestowing proper care in the preparation of seed-bed, thin sowing and proper manuring. Importance is also given to sieve out strong well-filled seeds by using brine water. Preparation of the nursery beds is done generally before sowing. The land is ploughed to a depth of $3\frac{1}{2}$ " and $4\frac{1}{2}$ " after which the soil is cultivated and irrigated. The beds are approximately $3\frac{1}{2}'$ to $4'$ wide and the bed length varies with the seedling requirements. The beds are raised 2" to 3" above the field level to facilitate drainage. Mixed organic fertilisers are generally recommended for the seed-bed. Ammonium sulphate and other water-soluble fertilisers are thoroughly mixed with soil before the rice seeds are sown. Wood ashes are applied when the seedlings are about 1" in height. 2 lb. of nitrogen and 1 lb. each of P_2O_5 and potash are applied per cent. The seed is sown at the rate of 2 lb. per cent. and 3.5 cents of such seed-bed is used for planting one acre of paddy field. The seed is sifted through a sieve and then the light seed is removed by soaking the seed in brine solution of specific gravity of 1.13. Then the seeds are washed and soaked in pure water and drained. Sprouted seeds are sown in the seed-bed area. The weeding of the seed-bed is another special feature. It is also recommended by the Government officials that the seed be treated with Uspulum, a mercuric fungicide to control seed-borne diseases.

(2) *Preparation of Fields for Planting and Manuring.*—The preparation of fields for planting is done thoroughly. Chinese vetch or soyabans are often grown for green manure. After the green manure crop has been cut and dried for two or three days it is ploughed under. Irrigation water is added to prevent the loss of nitrogen through aerobic bacterial activity. The amount of green manure crop harvested varies from 4,000-7,000 lb. per acre. The green manures are turned under about three weeks before the rice is transplanted to avoid the injurious effects caused by the decomposition products of fresh plant material. It is also the practice to supply 670 lb. of lime whenever green manures are used. It can be thus seen that the organic manures are applied to the land before actual puddling. Based upon the properties of the soil, the standard amount of manures and commercial fertilisers required to produce satisfactory yields has been determined for the various rice-growing regions of all the prefectures. The average amount of the three principal plant food elements applied are: nitrogen 80-100 lb. per acre; phosphate 60-80 lb. per acre; and potash 50-80 lb. per acre. Two-thirds of this manure mixture is applied as a sub-surface application in rice soils before letting in water for puddling, one-third is applied in two later applications, one about two to three weeks after planting and another two to three weeks before ear-emergence. Because of the shortage of fertilizers in recent years the farmers have attempted to increase the production of farmyard manures and a heavy dose of compost is applied to the field just before puddling.

Nearly 90 per cent. of the rice area in Japan is transplanted. The rows are usually 8"-12" apart, while the hills in the rows are between 3" and 8" apart. The spacing is determined by climate, soil fertility, amount of fertilizer applied and time of transplanting and variety. More seedlings are planted for low-tillering varieties or where tillering is low because of cool climate, infertile soil, lack of sufficient fertilizers or delayed transplanting.

(3) *After Cultivation.*—Inter-culturing is another important cultural operation done by a hand rotary weeder. This not only helps to bury the weeds but also helps in stirring the soil round about the roots and the fertilizer gets well mixed up with the soil which encourages tillering. The first interculturing is done 10-14 days after transplanting. It is repeated after intervals of about 10 days and stopped a week before the normal flowering

time. The standard depth of irrigation water is usually 1"-2". The fields are drained when the rice begins to ripen, i.e., when the heads start to turn down. Water is usually applied by canal but occasionally it is pumped from wells.

DISTINGUISHING FEATURES OF JAPANESE CULTIVATION

The striking differences between the methods of cultivation described above and the general cultivation practices recommended by the various Agricultural Departments in India are:

(i) sieving of the seed and soaking of the same in brine water to remove the light and ill-filled seeds, (ii) heavy application of commercial fertilizers both for seed-bed as well as for transplanted fields, (iii) inter-cultivation for which the cultivator plants the crop in lines. The practice of sieving the seed is commendable, but a few experiments carried out in India show that yield from the crop raised from light seeds is not significantly different from that raised from healthy seeds. As a cultivation practice, it should be followed in view of better germination and good stand. Regarding the application of manures, it has been generally found in India that the yield response obtained from the application of more than 40 lb. of nitrogen is not remunerative and economic. When compared to Japan, where with high doses from 50-80 lb. nitrogen, the responses are of the magnitude of 20-30 lb. paddy for every lb. of nitrogen applied, in India on the other hand, there is a very low response of even less than 10 lb. of paddy for 1 lb. of nitrogen under such high doses. Even the favourable response obtained with doses of 20-40 lb. nitrogen is of the order of 15 lb. of paddy per 1 lb. of nitrogen. In most of the areas, the application of higher doses of nitrogen induces profuse vegetative growth resulting in the premature lodging of the crop and reduction in yields. The supply of ammonium sulphate in the country is also limited and even with the minimum recommended dose of 150 lb. per acre, a quantity of about 5 million tons of ammonium sulphate will roughly be required for 75 million acres of rice land alone. As it is, the schedule production both at Sindhri and Travancore, will not exceed more than 0.5 million tons a year. Realising this, the propaganda of the various Agricultural Departments is more towards growing green manure crops and the application of organic matter like compost supplemented by a moderate application of ammonium sulphate. Heavy doses of these artificials are not, therefore, insisted on, but stress is laid on the

application of compost and green manures. Inter-culturing of rice is probably a new one. This, perhaps, has a value in connection with the application of higher doses of nitrogen for getting better response. Further research on this aspect is needed.

India, like Japan, has enough technical information for increasing rice production in the country. In Japan, however, experimental results have been adopted quickly with the help of an efficient extension organisation. There is also an additional advantage of protected irrigation for over nearly 90 per cent. of rice area. There is a technician for every two or three square miles in Japan, while in India, the extension machinery has still to be strengthened.

As it is, we have now only one demonstrator in a taluq comprising several villages and, as such, personal contacts between the technician and the actual villager are few and far between. With the completion of the new irrigation projects which will supply more assured and timely irrigation water, and by popularising the intensive methods of rice cultivation and making the supplies of fertilizers and improved seeds available to the cultivators, rice production is bound to be substantially raised and the country made self-sufficient in her rice requirements.

N. PARTHASARATHY.

Central Rice Research Institute,
Cuttack.

CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE

THE Central Building Research Institute, Roorkee, the eleventh in the chain of National Research Institutes to be set up under the auspices of the Council of Scientific and Industrial Research, was formally declared on 12th April this year by Maulana Abul Kalam Azad, Minister for Education and Natural Resources and Scientific Research, Government of India, and Vice-President of the C.S.I.R.

The establishment of this Institute was recommended in 1944 by the Building Research Committee set up by the C.S.I.R. As a start, a Building Research Unit was organised at Roorkee to work in co-operation with the Thomason College of Engineering, now the Technical University of Roorkee. As in the case of other national research institutions, research work did not wait for the erection of the Institute's buildings, but was started as early as 1947 in temporary quarters. The foundation-stone of the new building was laid in 1951 by the Hon'ble Shri Prakasa.

The Institute has been constructed on a site of 10 acres leased by the U.P. Government and the Roorkee University and an additional area of 57 acres has been acquired for further expansion. It consists of four blocks, the main block containing the Chemical and Physical Laboratories, the Technological Block housing the Soil Mechanics Laboratory and Workshops, the Library and the Museum Block and an Auditorium Block with a Lecture Hall having 250 seats. Very briefly, the Institute is dedicated to research which will step up the quality of building construction in India, while reduc-

ing its cost. To achieve this purpose, it will undertake surveys on building materials and construction on national scales and carry on research in building materials, methods of construction and the performance of buildings.

The problems for investigation in an Institute of this type are largely common to different countries, but there are some which are of special interest to India. The Institute will therefore pay special attention to problems like factors governing comfort and efficiency under tropical conditions, study of soil stabilization, use of indigenous materials, utilization of industrial wastes, construction of houses for persons of low income on an extensive scale, etc. The work of the Institute will deal with these problems under four main heads, *viz.*, problems relating to (a) building materials, (b) methods of construction, (c) performance of buildings, and (d) survey and information. Mention may be made particularly of four typical problems whose satisfactory solution will have a great significance for the development of our building industry. They relate to improvement in the quality of bricks, the possible use of bamboo as a reinforcing material, investigation on novel methods of construction, evolved by the Institute itself or by others, pre-fabrication and assembling of building components, heat and sound insulation, resistance to moisture penetration, fire and weather, consideration of new architectural and structural designs and problems relating to brick industry, lime industry.

NEW LIGHT ON THE EARLY PHYLOGENY OF THE VASCULAR PLANTS AND ON THE INFLUENCE OF CYCLES OF PAST GLACIATION AND MOUNTAIN-BUILDING ON PLANT EVOLUTION*

K. JACOB AND MRS. CHINNA JACOB

Geological Survey of India, Calcutta

IN two recent papers^{1,2} by the present authors and Mr. R. N. Shrivastava, several types of cutinised spores and tracheids of vascular plants from known Cambrian sediments in India were reported. These are of some importance as very few authentic remains of vascular plants are known from sediments earlier than the Middle Silurian. It was not suspected till recently that the vascular plants could have evolved as early as the Cambrian. As only to be expected, the spores recovered by us, most of them with well-developed tri-radiate marks, belong to the lower groups of vascular plants, namely, the primitive Pteridophyta and the Pteridospermæ. The tracheids obtained are too fragmentary for reference to any particular group. But they all possess simple pits.

It is now fairly certain that vascular plants were evolved even as early as the Cambrian. A careful study of the spores indicates that for them to have reached this stage of development, the plants to which they belonged might have had a long period of evolution, most probably extending back even to the late Pre-Cambrian (? Proterozoic).

Spores and tracheids of vascular land plants were obtained from known horizons in the Middle and Upper Cambrian sediments of Kashmir, Spiti and the Salt Range.¹ Comparative study of these somewhat poorly preserved spores with those of the known younger Palæozoic groups of plants cannot be considered satisfactory. Between the Middle and Upper Cambrian, and the Devonian or Carboniferous a long span of time had elapsed during which the earliest vascular plants should have undergone rapid evolution. But it would appear that the spores which are the reproductive elements, retained their essential distinctive features of the groups thus enabling us to suggest to a certain extent their possible affinities. From the study of these Middle and Upper Cambrian spores¹ we suspect that the representatives of the primitive Pteridophytes and the Pteridosperms had already been differentiated as distinct stocks at least by the Middle Cambrian time. The spores had already reached a fairly high stage of organisation including the development of rudimentary wings or bladders in

some. This surprising result induced us to look for the remnants of comparatively more primitive plant remains in earlier sediments.

Investigations were therefore extended to still earlier sediments than the Middle Cambrian, and from the upper part of the Lower Vindhyan, a horizon believed to be older than the Cambrians considered above, several well-preserved spores, possibly referable to the primitive Pteridophytes, and (?) the Pteridosperms were recovered.² The age of the Vindhyan is doubtful, but there is accumulating evidence that the Lower Vindhyan may be Lower Cambrian in age, if not older.

Amongst the Vindhyan spores believed to be Pteridophytic, we suspect the presence of those of the Psilopsida, Lycopsida and (?)² the Sphenopsida. The Pteridosperms (of the Pteropsida) are also possibly represented. If our surmises are correct, we are inclined to put forward the tentative suggestion that the Psilopsida, Lycopsida and (?) the Sphenopsida among the primitive Pteridophytes, and possibly even the Pteridosperms of the group Pteropsida had already developed as distinct lines of evolution even in the early Cambrian possibly getting back to the late Pre-Cambrian. It is not quite impossible that the Pteropsidan Cœnopteridales and Cordaitales might be traced in strata older than the Devonian.

The differentiation of these major primitive plant groups, i.e., the Psilopsida, the Lycopsida and (?) the Sphenopsida, even in such early geological times seems to suggest that they had evolved probably *along parallel lines from distinct ancestral stocks of higher Thallophytes or some form of "vascularised thallus"* about which we can make very little surmises at present. The Pteridospermæ of the group Pteropsida probably originated from the Psilopsidan stock very early in the Lower Cambrian, if not in the late Pre-Cambrian.

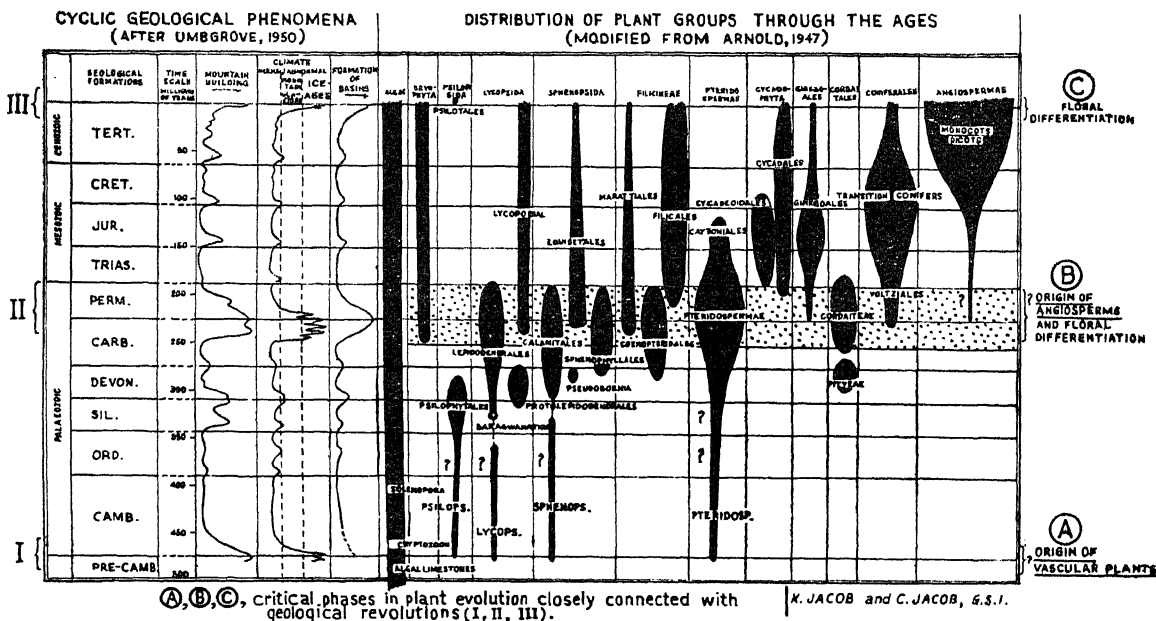
It is not quite certain whether or not the two lines of the main radiations in the Cormophyta, namely, the Stachyosporous (the Psilopsida, the Lycopsida and the Sphenopsida) and the Phyllosporous (the Pteridospermæ in part) groups were differentiated as early as the Lower Cambrian; for, at present, we are ignorant of the Pteridospermous spores obtained by us from the Lower Cambrian belong to Stachyosporous or Phyllosporous plants. The advanced groups

* Published by permission of the Director, Geological Survey of India.

of vascular plants of the Pteropsida (the Filicinae, the higher Gymnospermæ and the Angiospermæ) were probably derived in later geological periods from the major primitive groups mentioned above.

Elsewhere,³ while discussing the origin of the Angiosperms, we put forward the tentative suggestion that the rigours of the late Carboniferous glaciation of the Southern Hemisphere and the other marked changes in environmental conditions brought about by the accompanying geological convulsions might have induced certain of the advanced Gymnosperms or Pteridosperms to protect their seeds more efficiently, thus giving rise to the first Angiosperms probably along more than one line of development. It may not be very unlikely that the first vascular plants too came into existence as a direct consequence of the extreme climatic conditions

In the left half of the accompanying Chart, the rhythmic geological phenomena are graphically represented (after Umbgrove⁴) and in the right half is shown the distribution of the plant groups in geological time (modified from Arnold⁵). From the Chart, the origin of the early land plants is apparently closely related to the geological revolutions of the late Pre-Cambrian (I, A, in Chart). Later in the late Palæozoic, by which time several major groups of plants had been well differentiated, a very critical period in the history of the plant kingdom is remarkably exemplified in the Permo-Carboniferous (approximately between 212 and 250 million years), when the next cycle of major geological convulsions took place (II, B, in Chart). During this critical phase (stipled portion in Chart) certain large and established groups of plants were wiped out while others



GRAPHIC REPRESENTATION OF CYCLIC GEOLOGICAL PHENOMENA & THEIR INFLUENCE ON PLANT EVOLUTION THROUGH THE AGES

of the late Pre-Cambrian glaciation when, as in the late Carboniferous, the apparently cyclic processes of mountain-building, basin formation, regression of sea-level, magnetic extrusion (bringing about changes in CO_2 available in the atmosphere), etc., were pronounced geological phenomena which too probably helped to accelerate evolutionary tendencies in organisms existing during that time (see in Chart I, A; II, B). Some of these phenomena were probably closely connected with the amount of solar energy reaching the earth,

came into existence. The origin of the Angiosperms or the flowering plants was also probably connected very closely with the major revolution of this period³ (II, B, in Chart). Thus the two most vital steps in the evolutionary history of the plant kingdom, namely, first the advent of the vascular land plants (A, in Chart), and later of the flowering plants or Angiosperms (B, in Chart), may perhaps be considered to be the direct responses of the two major geological revolutions of the late Pre-Cambrian (I, in Chart) and the Permo-Carboniferous (II, in

Chart) respectively, on the adaptive processes of the plant organisms. The Voltziales and other transition Conifers, the Ginkgoales, the Cycadales, the Bennettitales and the true ferns may be said to have evolved during the critical phase in the Permo-Carboniferous while the Lepidodendrales, the Calamariales, the Sphenophyllales and the Cœnopteridales faded out completely (II, B, in Chart).

The third major revolution (III, in Chart) which was initiated in the Pleistocene was mainly responsible in breaking up the more generalised floras into the complex pattern of plant association which exists to-day (III, C, in Chart). It was then that the second peak of floral differentiation (botanical provinces) took place, the first having occurred in the Permo-Carboniferous.⁷ But it should be noted that the Pleistocene revolution which may be considered to be still in progress, "began far too recently for us to observe more than the beginnings of its effects on plant evolution".⁶ Thus, except during these three phases of major geological revolutions (late Pre-Cambrian, Permo-Carboniferous and Pleistocene), evolution in the plant kingdom may be said to have progressed slowly during the intervening periods creating no spectacular changes probably because the hereditary characters of the germ cells remained comparatively stable in the absence of any

markedly violent environmental changes like extensive glaciation, large-scale mountain-building, regression of sea-level, etc. Such physical factors might have generally determined the basic patterns along which the plant kingdom developed through the ages.

It is indeed a fascinating suggestion put forward by Umbgrove^{4,7} that the more or less equal intervals of about 250 million years between each of the three major revolutions and the accompanying spurt in plant evolution, probably represent the time required for a full rotation of our galactic system! It is becoming increasingly apparent that in order to make as complete an appreciation as possible of the factors that influenced organic evolution we shall have to look beyond the confines of the earth.

We are grateful to Dr. M. S. Krishnan, Director, Geological Survey of India, for his keen interest in the work.

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"JET STREAM" UNDER STUDY

STUDIES recently completed by Dr. Vincent J. Schaefer, of the General Electric Company, U.S.A., show that winds in the "jet stream" blow at speeds ranging from 80 to more than 200 miles an hour at altitudes of 20,000' to 50,000'. These winds often double the speed of high-flying aircraft. It is found that the "jet stream" shifts about over the northern hemisphere as the seasons change. It moves often from south-west to north-east, but occasionally veers to the west, north-west or north. Sometimes two or more streams may be identified. In summer, the speed of the winds in the stream decreases to about half of the tremendous winter-time speeds.

Other indications of the proximity of the major axis of the stream include gusty winds at the ground level; persistent cool, crisp air; generally blue skies with visibility unlimited, and rapid changes in the amount of sky covered by clouds. When the "jet stream" is nearby, the coverage of the sky by clouds often changes from one-tenth of the sky to nine-tenths and back again in less than an hour.

Scientists believe that this air corridor may be responsible for many unusual weather con-

ditions for which there has previously not been any adequate explanation. Thus, for example, the stream can quickly carry extremely cold air from the north to warm southern areas and can convey tropical air masses to the north in the space of a few hours. Many floods, droughts and persistent hot and cold spells are also attributed to its influence.

In the past there has been no way to locate the "jet stream" quickly in order to warn aircraft or to study its probable effects on the weather. Dr. Schaefer's studies have now shown that its location and the direction of its winds could be determined by carefully co-ordinated observation of cloud formations by weather stations located in different parts of a country.

Four "specific and rather spectacular" cloud types are visual indicators of the location of the high-speed wind stream. There are cirrus streamers, high cirro-cumulus clouds, alto-clouds and billowing alto-cumulus clouds that often extend from horizon to horizon, with parallel waves running at right angles to the direction of the air flow.

RESEARCH COLLECTION OF MAMMALS

A SURVEY was carried out by the Bombay Natural History Society between 1911 to 1923 with a view to collect a series of carefully prepared and labelled skins and skulls of India, Pakistan, Burma and Ceylon for a critical study of their taxonomic status, variations and distributions. The survey was carried out by trained collectors, and a large collection, consisting of about 26,000 skins and as many skulls, was made at a cost of Rs. 1,80,000. The collection was then critically studied, identified, labelled and the more interesting groups or at least known groups reported upon by the experts at the British Museum, which greatly enhanced the value of the collection. In accordance with the conditions of an agreement between the Bombay Natural History Society and the British Museum, the latter selected 8159 specimens for their own collection and the rest has been lodged with the Society.

In view of the great scientific value of this collection to Indian Mammalogy and because of the great loss sustained by the national zoological collection during the flood of 1943 at Banaras, the Zoological Survey of India decided to obtain a representative set of specimens from the Mammal Survey Collection. In 1949, Dr. S. L. Hora, Director, Zoological Survey of India, on his way back from the U.S.A., visited the British Museum to examine this collection and discussed with the authorities of the British Museum the problems of its return to India. On his arrival in India, he impressed on the Bombay Natural History Society, the owner of the collection, the great value of the specimens lying in London and the urgency of their early removal to India. The Zoological Survey of

India offered to acquire a part of the collection and to pay for certain other contingent expenses. Thanks to the generosity of the Scindia Steam Navigation Company, the whole collection was brought to Bombay free of charge, though much had to be spent in verifying, listing and packing the specimens before its despatch from London.

On account of the great value of the collection, the Bombay Natural History Society was approached by some of the Governments of the countries surveyed and also by some foreign museums for the purchase of specimens. The Zoological Survey of India was, however, given the priority right and has obtained for the National Collection 3558 skins and an equal number of skulls, this being 20 per cent. of the total collection received from London. This percentage, was, however, restricted to the total number of specimens selected and the Survey was given freedom to select upto 40 per cent. from any group which was poorly represented in the National Collection. Such a basis for the division of the collection has tremendously increased the value of the share of the Zoological Survey for scientific research purposes.

The work of selecting specimens for the National Collection was entrusted to the Mammal Assistant, Shri. H. Khajuria. The specimens selected for the Zoological Survey of India include 408 forms, many of which are very rare and many are new to the National Collection. About 95 per cent. of the specimens selected had been collected from localities and in seasons which are unrepresented in the collection of the Survey.

SIR LAWRENCE BRAGG

THE managers of the Royal Institution have appointed Sir Lawrence Bragg, F.R.S., to the offices of Fullerian Professor of Chemistry, Resident Professor, and Director of the Institution's Laboratories. He will take up the duties

of the Fullerian Professorship immediately and the Laboratory and Resident duties on January 1, 1954. Sir Lawrence Bragg has been Cavendish Professor of Experimental Physics, Cambridge University, since 1938.

PROF. JAMES W. MCBAIN—OBITUARY

THE sudden passing away of Professor James W. McBain, formerly Director, National Chemical Laboratory of India, Poona, due to a heart attack on March 12, 1953, in California, will be received with deep regret both in India and abroad.

Prof. McBain was born on March 22, 1882, at Chatham, New Brunswick, Canada, and passed most of his boyhood at Port Dover, Ontario, Canada, and at Providence, Rhode Island, U.S.A. He obtained the degree of M.A. in 1904 from the University of Toronto and Ph.D. from the Universities of Leipzig and Heidelberg. He started his career as a Lecturer in Physical Chemistry at Bristol University, England. Honours came to him fast from all directions. In 1906, he was made Leverhulme Professor of Physical Chemistry in a chair created for him by the late Lord Leverhulme, in recognition of his fundamental researches on soap.

He was elected Fellow of the Royal Society in 1923 and offered the post of Professor of Chemistry at Stanford University, California, in 1926 and awarded the Davy Gold Medal of the Royal Society in 1929 for his pioneer and outstanding work on the physical properties of soap. He was starred in *American Men of Science* in 1933, elected Fellow of the New York Academy of Social Sciences in 1940 and of the California Academy of Sciences in 1946. He represented the United States at the Centenary of Mendeleef at Leningrad, U.S.S.R. and flew round the world to attend the 220th Anniversary of the Academy of Sciences of Moscow.

He did a splendid job in training 1,300 officers of Cadet Battalions and captaining the Territorial Forces in the First World War for which his name was mentioned in despatches.

He had been Consultant on Research Committees of Colloids, Corrosion, Building Materials, Dental Materials, Adhesives and to the Oil Companies of California and Lever Brothers.

He was Chairman of Colloid Division, American Chemical Society, Vice-President of the Faraday Society, President of the Association of University Teachers of Great Britain, Guest of Honour at the Meeting of the International Union of Pure and Applied Chemistry at Cambridge, England, a Member of the Editorial Board of the *Journal of Physical Chemistry* and the *Journal of Colloid Science*.

Prof. McBain was a world authority on the colloid chemistry of soaps and published over 400 memoirs on various aspects of physical chemistry, notably those relating to the molecular structure of soap solutions, the McBain-Bakr sorption balance, which presents a simple quantitative method of determining surface areas and the simplest air-driven spin-top ultracentrifuge with photographic recording.

He is the author of two reference books, one entitled *The Sorption of Gases by Solids* and the other *Colloid Science* discussing with authority, insight and discrimination, fundamentals and important aspects of the subject. He delivered two of the Frontiers of Chemistry Lectures in 1943 which were published recently in the book entitled *Frontiers of Chemistry*.

The zeal and single-minded devotion with which he worked for the development of the National Chemical Laboratory of India, won him the esteem of his colleagues. He encouraged healthy criticism, original thinking, initiative and enterprise in every scientific worker. He showed keen interest in the social life of scientists working in the NCL and donated the McBain Colony Centre, housing the NCL Club and Co-operative Stores, on his 70th and last birthday on 22nd March 1952.

Prof. McBain is survived by his wife Dr. Mary Evelyn McBain, daughter Junet and son John McBain, to whom we offer our most sincere sympathy in their bereavement.

J. P. VARMA.

IONOSPHERIC RECORDING

THE results of observations on the ionosphere carried out by the Radio Research Station, D.S.I.R., from 1930 to 1946 are now available in the form of a Report* which discusses the results in general terms and describes the development of ionospheric recording in this country. It contains tables from which a particular range of observations can be chosen and explains how the detailed results can be obtained.

Regular ionospheric recording began at Slough in 1931. Since then, as knowledge and technique have grown, the scope and frequency of the measurements have been expanded. For the

past few years, the results of these measurements have been compiled in tables and circulated to the Post Office, the B.B.C., radio communication companies, shipping lines, airlines, scientists, engineers and others concerned with radio transmission. A large quantity of detailed material, however, has not been available before now except in small amounts and on special request.

* Radio Research Special Report No. 23, available from H. M. Stationery Office, London, S.E. 1—Price 1s. 7½d. by post.

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THE C-C BONDS IN CYCLO-OCTA-
TETRAENE C_8H_8

THE nature of the C-C bonds in cyclo-octa-tetraene is a disputed question. Though the mean latent heat of vaporization, 9.8 K. calories/mole in the region 42-143°C. and the entropy of vaporization at boiling point 23.7 cal./deg. (Reppel¹) and the resonance energy 25.3 K.cal. (Pink and Ubbelohde²), compare with the corresponding quantities 7.0, 19.73 and 39 respectively for benzene, the diamagnetic susceptibility² (-51.9×10^{-6}) accords with a cyclic system of conjugated double bonds. From the electron diffraction studies, Bastiansen and Hassel^{3,4} state that though it was not possible to say that the C-C distances were exactly equal, their mean distance being 1.42, they were definitely not single and double bonds (symmetry D_{4d} or D_4). Hedberg and Schomaker⁵ finds them 1.33 and 1.45 Å and Karle⁶ 1.35 and 1.50 (Symmetry D_{2d}). But the latter states that there is

reasonable agreement with the radial distribution curves for one C-C distance 1.42 Å° though the average displacement from equilibrium is slightly larger (~ 1 Å°).

From Raman and infra-red studies, Langseth³ suggested a crown form D_{4d} with all equivalent bonds; Lippincott, Lord and McDonald⁷ a crown form D_4 with non-equivalent bonds, and Fleet, Cave, Vago and Thompson⁸ a tub from D_{2d} . Saksena and Narain^{9,10} calculated the C-C force constant for the structure D_{4d} as 5.7×10^5 dynes/cm. but they were obliged to consider 1651 as a C-H frequency. They found, however, that the frequencies 194, 875 and 1651 cm^{-1} could represent the three polarised ring frequencies for the D_4 structure though they remark that there was better agreement with observed frequencies for equal than for unequal values of C-C force constants.

We have revised the calculations of Saksena and Narain for the structure D_4 (there appears

to be a small error in the calculations) and have made new calculations for the D_{2d} structure both for C_8H_8 and C_8D_8 molecules. The isotopic molecule was not considered by Saksena and Narain. We have calculated the three polarised ring frequencies belonging to the totally symmetric class for the two structures by considering CH a group of mass 13 and CD of mass 14. According to Lippincott, Lord and McDonald¹¹ there are six polarised frequencies 172 (10), 812 (4), 822 (9), 1636 (9), 1651 (10) and 2250 (10) cm^{-1} in C_8D_8 . The last is a CD-stretching frequency and 1636 (9) and 1651 (10) represent a Fermi splitting due to the octave of 822. We, therefore, consider 172, 822, 1636-1651 as the three polarised ring frequencies in C_8D_8 corresponding to 194, 875, 1651 in C_8H_8 . Narain,¹² however, considers 811-822 as another Fermi splitting. For our calculations we have used the C-C distances as 1.34 and 1.54 \AA and C-C-C angle as 125° for structure D_4 and the distances as 1.33 and 1.45 \AA and C-C-C angle 127° for structure D_{2d} .

The results are shown in Table I. It may

TABLE I

| | $K_1 \times 10^{-5}$ dynes/cm. | | | $K_2 \times 10^{-5}$ dynes/cm. | | | $K_3 \times 10^{11}$ dynes/cm. radian | | | C_8H_8 | | | C_8D_8 | | |
|----------|-----------------------------------|---------|---------|-----------------------------------|---------|---------|---------------------------------------------|---------|---------|----------|---------|---------|----------|---------|---------|
| | ν_1 | ν_2 | ν_3 | ν_1 | ν_2 | ν_3 | ν_1 | ν_2 | ν_3 | ν_1 | ν_2 | ν_3 | ν_1 | ν_2 | ν_3 |
| D_4 | 9.0 | 4.3 | .177 | 1691 | 799 | 198 | 1630 | 769 | 190 | | | | | | |
| | 8.0 | 5.3 | .177 | 1667 | 848 | 195 | 1606 | 816 | 187 | | | | | | |
| | 7.0 | 6.3 | .177 | 1658 | 869 | 195 | 1597 | 836 | 187 | | | | | | |
| | observed | | | 1651 | 875 | 194 | 1636 1651 | 822 | 172 | | | | | | |
| D_{2d} | 9.0 | 5.0 | .9 | 1737 | 815 | 194 | 1673 | 785 | 186 | | | | | | |
| | 8.0 | 6.0 | .9 | 1721 | 849 | 194 | 1657 | 817 | 186 | | | | | | |
| | 7.0 | 7.0 | .9 | 1716 | 861 | 194 | 1652 | 826 | 186 | | | | | | |
| | 6.5 | 6.5 | .9 | 1651 | 831 | 194 | 1590 | 800 | 186 | | | | | | |

K_1 and K_2 are the force constants of C-C valence and K_3 of C-C-C deformation.

be seen that both ν_1 and ν_2 deviate most from the observed data for the values of C-C force constants corresponding to single and double bonds (9.0 and 4.5). It may be argued that these differences could be removed by using the interaction terms $f_{12} \Delta r_1 \Delta r_2$ and $g \Delta r \Delta \theta$ (f_{12} and g positive) in the potential energy function. Recent work on interaction force constants, however, shows (Coulson and Longuet Higgins¹³; Coulson, Duchesne and Manneback¹⁴; Duchesne¹⁵; Richardson and Wilson¹⁶) that these terms arise from three distinct causes: (1) resonance effects, (2) interaction between non-bonded atoms, and (3) changes of

hybridization. Since we are mainly concerned with the first of these, the interaction terms should be zero when the C-C force constants are those for a pure C=C and a pure C-C bond, viz., 9.0 and 4.5. Therefore, one should expect to find the best agreement between the observed and calculated values of frequencies in this case, but it is not so. This suggests, in agreement with the finding of Bastiansen and Hassel and the existence of resonance energy, that pure double and pure single bonds are not present in the molecule.

A complete study of the D_4 and D_{2d} structures is in progress.

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February 1953.

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RESOLVING POWER OF THE FABRY-PEROT ETALON

For the Fabry-Perot Etalon the intensity at any point of order n is given by¹

$$I = I_0 / (1 + F \sin^2 \pi n) \quad (1)$$

where the symbols have the usual meanings.

Considering two spectral lines of equal intensity separated by an order Δn the maximum and minimum of the resultant intensity pattern are given by¹

$$I_{\max} = I(n) + I(n + \Delta n)$$

$$I_{\min} = 2 I(n + \Delta n/2).$$

Applying Abbe criterion of resolution, namely,

$I_{\min} = 0.981 I_{\max}$, we get

$$\begin{aligned} & \{1 + F \sin^2(\pi \Delta n)\} \{1 + F \sin^2(\pi \Delta n/2)\} \\ & + \{1 + F \sin^2(\pi \Delta n/2)\} \\ & = (2/0.981) \{1 + F \sin^2(\pi \Delta n)\} \quad (2) \end{aligned}$$

Taking $\sin(\pi \Delta n) = (\pi \Delta n)$ and $\sin(\pi \Delta n/2) = \pi \Delta n/2$ to a first approximation, as was done by Meissner² and Candler³ (for their calculations on Rayleigh and Sparrow criteria respectively), Eqn. (2) reduces to a quadratic in $(\pi \Delta n)^2$. The positive root is $(\pi \Delta n)^2 = 2.2706 F$, giving

$$\Delta n = F^{-1/2}/2.085. \quad (3)$$

If n_0 is the order of the central fringe, the resolving power is given by⁴

$$\lambda/d\lambda = n_0/\Delta n = 2.085 n_0 F^{1/2} \quad (4)$$

Similar calculations have been made on the Rayleigh² and Sparrow³ criteria. The table below gives the resolving power of the prism, the grating and the Fabry Perot etalon, as calculated from the three main criteria.

TABLE I
Resolving power of optical instruments

| Instrument | Rayleigh's criterion | Sparrow's criterion | Abbe's criterion |
|-------------|-------------------------|------------------------|------------------------|
| Prism | $td\mu/d\lambda$ | $1.26 td\mu/d\lambda$ | $1.145 td\mu/d\lambda$ |
| Grating | Nn | $1.26 Nn$ | $1.145 Nn$ |
| F.P. Etalon | $1.49 n_0 F^{1/2}$ | $2.72 n_0 F^{1/2}$ | $2.085 n_0 F^{1/2}$ |

The table is sufficient to stress the importance of Fabry-Perot Etalon as a means of deciding between these three criteria.

The author acknowledges thanks to Dr. K. Majumdar and Mr. Y. P. Varshni for their interest in the investigation.

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ON THE ORIGIN OF ILMENITE PLACERS OF RATNAGIRI (BOMBAY)

DURING a short visit to the coastal area of the district, the author came across a number of placers of ilmenite and iron ore. The most important of these is at Malgund.

The area is covered by basalts and some dolerites. The microscopic studies show that the

traps have been subjected to metamorphism and that probably they represent the deeper flows in the Deccan traps. There is no reason to doubt that titanium is an ingredient of the basaltic magma. Plateau basalt contains about 2.6% TiO_2 . When this magma intrudes granitic shell, or spreads on the surface, titanium crystallises in the form of ilmenite or as the high temperature titaniferous augite. Ilmenite is one of the earliest minerals to crystallise and, therefore, the simplest explanation of its origin in these rocks is that it is concentrated by crystal-settling and fractional crystallization. But this should give rise to universal occurrence of ilmenite in abundance in all the traps—which is not a fact. Though ilmenite is present in Deccan traps, it is only in this area that the concentration is rich enough to give rise to ilmenite placers. It seems more probable that the associated ilmenite has been brought here by three ways: (a) concentration of the early-formed crystals by crystal settling; (b) by accumulation of titanium and iron released from other minerals like augite, which are able to absorb as well as give out titanium under higher pressure temperature conditions; (c) by concentration of Ti, Fe, molecules and ions liberated from the higher zones, as these have a tendency to diffuse downwards.

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AN ADDITIVE FUNCTION OF CRITICAL CONSTANTS

RECENTLY several additive functions¹ depending on the physical constants, such as boiling points, have been proposed.

If T_c be the critical temperature and P_c the critical pressure, it is found that the function $T_c^2/\sqrt{P_c}$ is additive for the normal paraffins. Taking the value of P_c in atmospheres, the additive function may be denoted by J, where

$$J = T_c^2/100 P_c^{1/2}.$$

The contributions of the component atoms can be evaluated and are given in Table I. The data are taken from standard sources.² It will be noticed that the differences for successive hydrocarbons is very nearly the same. The mean value of J for the addition of a (CH_2) group is found to be 89.8. The observed data are well fitted in the formula $J_n = -58.9 + 89.8 n$, where n is the number of carbon atoms.

TABLE I

| No. of C atoms | Paraffin | T_c in °K. | P_c in atm. | J observed | J calculated |
|----------------|-------------|-----------------|------------------|---------------|-----------------|
| 1 | Methane | 190.7 | 45.8 | 53.75 | 30.9 |
| 2 | Ethane | 305.3 | 48.8 | 133.4 | 120.7 |
| 3 | Propane | 368.8 | 43 | 207.4 | 210.5 |
| 4 | Butane | 426.2 | 36 | 302.7 | 300.3 |
| 5 | Pentane | 470.4 | 33.04 | 385 | 390.1 |
| 6 | Hexane | 508 | 29.63 | 474.1 | 479.9 |
| 7 | Heptane | 540 | 26.89 | 562.4 | 569.7 |
| 8 | Octane | 569.4 | 24.66 | 652.9 | 659.5 |
| 9 | Nonane | 595.4 | 22.86 | 741.5 | 749.3 |
| 10 | Decane | 619.3 | 21.24 | 832.3 | 837.1 |
| 11 | Undecane | 642.6 | 19.92 | 925 | 928.9 |
| 12 | Dodecane | 663.8 | 18.59 | 1022 | 1018.7 |
| 13 | Tridecane | 683.2 | 17.55 | 1104 | 1108.5 |
| 14 | Tetradecane | 701 | 16.56 | 1208 | 1198.3 |
| 15 | Pentadecane | 717.6 | 15.75 | 1297 | 1288.1 |
| 16 | Hexadecane | 734.3 | 15.10 | 1387 | 1377.9 |
| 17 | Heptadecane | 749.3 | 14.41 | 1479 | 1467.7 |
| 18 | Octadecane | 763.2 | 13.83 | 1566 | 1557.5 |
| 19 | Nonadecane | 776 | 13.43 | 1644 | 1647.3 |

Excepting methane and ethane, the difference between the observed and calculated values of J is usually less than 1 per cent., which may be in some cases due to errors in critical temperature and pressure. The anomaly of methane and ethane is connected with the well-known fact that the lowest members of the organic series depart from the regular behaviour of the higher members.

If we substitute Van der Waals' values of T_c and P_c viz., $T_c = 8a/27bR$ and $P_c = a/27b^2$ in the J function, it is seen that $a^{3/2}/b$ is additive for the successive members of the normal paraffins.

The author is thankful to Dr. K. Majumdar and Dr. R. D. Tewari for their interest in the work.

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March 15, 1953.

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ULTRAVIOLET ABSORPTION SPECTRA OF MOLECULES CONTAINING SIX- AND FIVE-MEMBERED RINGS

In continuation of the previous work on the calculation of the electronic energy levels of indene,¹ the author has photographed the absorption spectra of indene, indole and thionaph-

thene (molecules possessing five- and six-membered rings) in vapour state and analysed them on the basis of the predicted allowed electronic transition $A' \rightarrow A'$. In each molecule two distinct regions of absorption are observed. In indene there is a third region of continuous absorption at ν 44430. The first absorption region in each case consists of discrete bands. The position at which absorption sets in and the vibrational frequencies determined from the analysis of the bands are shown below for the three molecules.

| Molecule | Onset of absorption | Excited state frequencies |
|---------------|---------------------|-----------------------------------------|
| Indene | ν 34729 | 357, 480, 807, 947, 1067, 1180 and 1344 |
| Indole | ν 35235 | 478, 717, 906, 1313 and 1454 |
| Thionaphthene | ν 34060 | 672, 736, 936, 1181 and 1331 |

The observational data and the discussion of the analysis will be published elsewhere.

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March 23, 1953.

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SHAPE ANALYSIS OF QUARTZ GRAINS OF SOME SANDSTONES

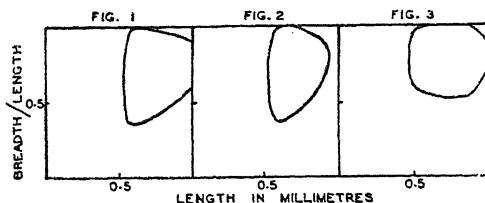
RITTENHOUSE¹ suggested the study of intercept sphericity in the elucidation of problems on the nature of sediments and their conditions of deposition. The three dimensions of a grain are determined and the shape value is derived from a chart using the breadth/length and flatness ratios. The apparatus in its simplest form consists of two glass plates with their flat surfaces held in contact at one end and wedged a measurable distance apart at the other end.

Shape values of quartz grains from three sandstones of Chintalapudi, Gollapalli and Rajahmundry formations in the Nuzvid area (Sheet No. 65 D/13) were calculated adopting this method. These values range as follows: Chintalapudi sandstones, 0.40-0.82; Gollapalli sandstones, 0.60-0.93; Rajahmundry sandstones, 0.63-1.00.

Scatter diagrams after Hagermann² are drawn for the three stratigraphic horizons with the length of the grain as abscissa and the ratio breadth/length as ordinate (Figs. 1, 2 & 3).

The significance of these results lies in that they afford some valuable confirmatory evidence of the nature of sediment and conditions

of deposition. The progressive and gradational increase in the shape values shows the partly re-worked nature of the younger sediments, namely, Gollapalli and Rajahmundry sandstones, an inference drawn on the basis of heavy mineral analysis.



Hagermann's diagrams for Chintalapudi and Gollapalli formations resemble each other in contrast to that of Rajahmundry sandstones. The essential similarity of conditions of deposition during the two stages of Gondwanas present here, and the striking difference in tertiary times are thus indicated.

My thanks are due to Professor C. Mahadevan, under whose helpful guidance this work was carried out.

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THE INCIDENCE OF THE Le^a BLOOD GROUP ANTIGEN IN INDIANS

A POWERFUL anti-Le^a serum was obtained from a routine blood donor of Group B. The antibody, which was active at 37°C., appeared to be of spontaneous rather than immune origin. The serum was tested by the tube method against the bloods of Indian adults of Groups B and O. The subjects tested did not constitute a distinct ethnological group. The results are shown in the table.

| Group | Number tested | Number positive |
|-------|---------------|-----------------|
| B | 100 | 28 |
| O | 100 | 29 |
| Total | 200 | 57 (28.5%) |

The incidence of positives appears slightly higher than in England and Scandinavia, in which countries the average incidence of Le^a positives is 22.04% (Race and Sanger, 1950).

As Le^a positive blood in adults is genetically homozygous (Andresen, 1947), the gene fre-

quency of Le^a in Indians calculated from the above results is $\sqrt{0.2850} = 0.5339$.

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A RAPID METHOD OF PHOTOMETRIC ANALYSIS OF VITAMIN B₁₂ IN CRUDE LIVER EXTRACTS

REICHSTEIN¹ had obtained a 90 per cent. yield of pure B₁₂ from liver extracts and streptomycetes broth, using phenol-CHCl₃ extractions. Consequently this method was used to obtain vitamin B₁₂ in a concentration in which the purple colour of its dicyano-complex² can be measured.

30 ml. Whole Liver Extract, adjusted to pH 4.5, is treated 3 times with 10 ml. phenol-CHCl₃ (1:6). To the combined extracts excess of ether (100 ml.) is added and vitamin B₁₂ is shaken out 4 to 5 times with portions of 2 ml. water, adjusted to pH 2.5. To an aliquot part of the combined aqueous extracts, 1 ml. KCN (10 per cent. solution) is added and the depth in colour measured and compared against a standard graph, prepared at the same pH with known amounts of vitamin B₁₂.

In the majority of 46 tests carried out so far the experimental error remained within 3 to 5 per cent. Recovery values of 50, 100 and 150 µg. crystalline B₁₂ (Merck.), added to 30 ml. of whole liver extracts were in good agreement with theoretical values. A proprietary product gave by this method in two trials on separate days 5.5 µg. B₁₂, which is in good agreement with the theoretical value (6 µg.), considering that this batch is about one year old (15-3-1952). In preliminary comparative trials the results were also in good agreement with those obtained with the lead anaemia in the rabbit.³

Further work is in progress.

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THE OCCURRENCE OF γ -AMINO
BUTYRIC ACID AND GLUTAMIC ACID
DECARBOXYLASE IN RED YEAST
(*RHODOTORULA GLUTINIS*)

In the course of our investigations on the amino acid composition of yeasts by Circular Paper Chromatography, it was found that the acid hydrolysate of a red yeast [identified by Centraalbureau Voor Schimmelcultures, Delft Holland as "*Rhodotorula glutinis* (Fres.) Harrison var. *rubescens* (Saito) Lodder"], gave a band in addition to tyrosine band between proline and valine bands when the chromatogram was run with *n*-butanol-acetic acid-water as solvent mixture. This band was identified as γ -amino butyric acid by spraying the chromatogram with sodium 1:2-naphthaquinone-4-sulphonate, which is a useful reagent for the identification of the amino acids as reported earlier by Giri and Nagabhushanam.¹ Its presence was further confirmed by running a mixed chromatogram with an authentic pure sample of γ -amino butyric acid (Nutritional and Biochemical Corporation, U.S.A.) and also by running two-dimensional chromatograms on large sheets of filter-paper using *n*-butanol-acetic acid-water as the first solvent and pyridine-water as the second solvent.² Although γ -amino butyric acid has recently been shown to be of widespread occurrence in plants, animal tissues, blood and urine, little is known of its occurrence in yeast, except the recently reported information on its occurrence in Difco yeast extract by Reed,³ who stated that the pathway to such a metabolite has yet to be established in living cells other than bacteria.

Although it has been shown that γ -amino butyric acid is produced by the action of bacteria on glutamic acid, the occurrence of the enzyme, glutamic acid decarboxylase, has not been shown to be present in yeast. Reed suggested that this amino acid is a degradation product. This view is based on the observation that freshly harvested yeast did not contain the amino acid, while it occurred in free state in autolysates of yeast.

The occurrence of γ -amino butyric acid in the acid hydrolysates of red yeast led us to trace the pathway for such a metabolite and the enzyme system involved.

The organism was maintained on wort agar slants and periodically subcultured every week. The cell material for experimental use was obtained by growing it in a medium composed of glucose (2%), ammonium sulphate (2.5%), glutamic acid (0.5%),⁴ salt solution (12.5 ml./100 ml.)* and citrate buffer, pH 4.6

(12.5 ml./100 ml.). Cultures were prepared by inoculating from stock cultures and passage through two transfers in this medium for 18 hours. Two litres of this medium after sterilisation were seeded with 100 ml. of active cells obtained from the second transfer and subjected to mild aeration under aseptic conditions for 18 hours. The cells were then harvested by centrifuging and washed twice with cold distilled water. The cells were frozen in a refrigerator for 40-60 minutes and then suspended in cold distilled water to give approximately 20 mg. dry weight per ml. and used for studying the decarboxylase activity. The reaction mixture used for testing the decarboxylase activity consisted of 0.5 ml. glutamic acid (50 μ M), 1 ml. of cell suspension (20 mg. dry cells) and made up to 2.5 ml. with M/15 phosphate buffer. The activity of the enzyme, glutamic acid decarboxylase, was determined by circular paper chromatography technique which has been successfully applied for studying transaminase systems.⁵ The reaction mixtures were incubated for 18 hours at 37°C. The colour intensities of glutamic acid as well as γ -amino-butyric acid bands separated on the chromatograms were measured in a Klett-Summerson Colorimeter according to the procedure described by Giri *et al.*⁶ The cell suspension showed maximum decarboxylase activity at pH 4.5. The occurrence of the enzyme in yeast suggests the possibility of the formation of γ -amino butyric acid in yeast by enzymic decarboxylation of glutamic acid. Further work on the purification and characteristics of this enzyme is in progress.

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February 26, 1953.

* Composed of KH_2PO_4 - 4.4 g., KCl - 3.4 g., MgSO_4 , $7\text{H}_2\text{O}$ - 1.0 g., $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ - 1.0 g. MnSO_4 , FeCl_3 , H_3BO_3 - 20.0 mg. each, ZnSO_4 , FeCl_3 - 8 mg. each, CuSO_4 and KI - 0.8 mg. each per litre of the solution

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MERCUROCHROME AS A HISTOLOGICAL STAIN

A COMBINATION of hæmatoxylin and mercurochrome has been found successful for the double-staining of animal tissues or sections. The latter chemical disodium-hydroxy-mercuridibromfluorescein, the disodium salt of 2, 7-dibromo-4-hydroxymercurifluorescein, containing 24 per cent. mercury and 18 per cent. bromine is also known as merbromin—($C_{20}H_8O_6Br_2Na_2Hg$). M.Wt. 750.7. A 1 or 2 per cent. solution of mercurochrome in distilled water gives satisfactory results and is easier to work with, than carmine or eosin; and the chances of over or understaining (a phenomenon of common occurrence) are very much reduced. After the sections have been stained with hæmatoxylin and washed, they are kept in the mercurochrome solution for three to five minutes and differentiated in running water. For mounting pure glycerine should not be used as mercurochrome tends to fade in it; but it keeps well in 25 to 30 per cent. solution of glycerine, which may be used as a temporary mounting medium for this stain.

For permanent mounting it is an ideal stain. Xylol adds to its brilliance after dehydration and the permanent preparations keep well for years without fading. Sections stained in 1945 are still as good as they were in the beginning. It has been tried on various animal tissues. In the heart of *Rana tigrina* it stained the truncus arteriosus brick-red, the lining of the valves deep pink with a slight tinge of violet due to hæmatoxylin, and the muscular fibres dull red. The ova of earthworm are stained lilac scarlet and the surrounding tissue very deep pink. The trachea of the cockroach bright red, and its salivary glands and the striped muscle fibres crimson red, the striations in the latter case become very distinct. I am using mercurochrome (May & Baker) as a stain for the last seven years in my classes and it has always given very satisfactory results.

I am thankful to Prof. K. Ramamurti of Birla College for the valuable information about the chemistry of mercurochrome.

Birla College, H. L. SHARMA.
Pilani (Rajasthan),
February 21, 1953.

AN ATTEMPT TO PURIFY INSULIN BY CHROMATOGRAPHY

DURING some work on insulin it appeared to us that the acetone extract of the precipitated picrates as obtained in the method of Dodds

and Dickens,¹ which is presumed to contain only insulin picrate, may be tested for its homogeneity by chromatographic adsorption. Various adsorbents were used for this purpose, e.g., alumina activated by heating for 2 hours at 200° C. in an atmosphere of CO_2 , as also the partially deactivated alumina obtained by the treatment of the activated one with alcohol; magnesia in the activated form (heating for 2-3 hours in a closed crucible with a burner), alone as well as in admixture with (i) activated alumina, (ii) sodium silicate, and (iii) sodium carbonate; the last two were not activated. The solvent used was acetone and the development of the chromatogram was effected, in each case, by washing first with a little acetone and then with a large quantity of it and finally with acetone-alcohol mixture.

The results indicate that the acetone extract of the total picrates obtained in the method of Dodds and Dickens, is not homogeneous as shown by the appearance of more than one band (generally three) when about 50 ml. of a 0.35 per cent. solution of insulin picrate in acetone is subjected to chromatographic adsorption.

The best results were observed in the case of activated alumina. The order, colour and the approximate width of the bands were 1.0-1.5 mm. (dirty-yellow to brown); 1.0-1.5 cm. (golden yellow); 0.7-1.0 cm. (colourless), and 1.0-1.5 cm. (light yellow). After keeping overnight this chromatogram appears as 1.0-2.0 mm. (brown or dirty yellow); 0.8-1.0 cm. (dirty white); 1.0-1.5 cm. (golden yellow), and 1.0-1.5 cm. (light yellow). Partially deactivated alumina gave more or less the same chromatogram as the activated one but the separation of the bands was not as well defined and the colour of the second band was light orange.

Elution experiments with water and acidic alcohol have tentatively confirmed that in these chromatograms, insulin picrate forms the middle band, generally golden yellow in colour. It was noted that by adding an aqueous solution of picric acid to the fully developed chromatogram, the lowest band quickly started diffusing downwards changing its colour to deep orange. There occurs a slight decrease in the width of the middle band by this treatment. Insulin picrate forming the middle band can be eluted by means of acidic alcohol and the hydrochloride precipitated by adding a large volume of acetone.

Since further work could not be done, it is considered desirable to send this preliminary note which might help the workers in this field,

The authors wish to record their thanks to Dr. (Mrs.) P. A. Rao for her kind interest in this work.

Chemistry Dept., AZIZUR RAHMAN,
Muslim University, (MISS) FATIMA MINHAJ,
Aligarh,
March 2, 1953.

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SULPHATE-REDUCING ORGANISMS IN THE SOILS OF RANN AREAS IN CUTCH

IN the course of soil survey work in Cutch, some soil profiles were examined in the tertiary alluvial areas of the mainland and in the recent alluvial areas of Little and Great Ranns of Cutch. Under the arid climate of Cutch, short seasonal grasses cover the grey soils of tertiary alluvium and generally the surface drainage is good. The Rann areas are devoid of any vegetation and remain under water for nearly six months in the year. Satyanarayana¹ described the general conditions prevailing in the area and the characteristics of the soils. These highly saline soil profiles exhibit zones of gypsum deposition, accumulation of iron in streaks and bands, and blue-green gley horizons. These characteristics suggested that anaerobic micro-organisms are possibly responsible for the changes taking place in the soils. Iya and Sreenivasaya² have reported and studied the sulphate reducing organisms (*Vibrio desulphuricans* Konæ) in the east coast soils of India. Datta,^{1,2} isolated an anerobic organism which reduced sulphate to elemental sulphur. It was thought fit to investigate the distribution and activity of anaerobic bacteria and particularly of sulphate-reducing organisms in Cutch soils.

A large number of soil samples were examined by seeding 1 g. of soil to 50 c.c. of van Deldens solution in 200 c.c. conical flasks. The flasks were kept under anaerobic conditions and the extent of H₂S production was noted by the blackening of the lead-acetate paper, attached to the cotton plug of the flasks.

Sulphate-reducing organisms were present in all the profiles but their activity was not uniform in the different horizons of the same profile. A high activity was noticed in 3"-15" layer of soils from the Rann area. In the deep gley horizon (66"-70") intense activity was

noticed while in a profile with a surface gley horizon (12"-33") the activity was negligible. Gypsum-bearing horizons showed high activity in some profiles and negligible activity in others. Similarly, in the iron accumulation layers (incipient iron pan formation) also the activity was not consistently of the same order. An interesting observation was that the mainland soils showed the presence of sulphate-reducing organisms, the activity being high in surface soils in one area and in the other, bottom layers showing the high activity.

An examination of some of the Indian soils of non-marine areas revealed the presence of sulphate-reducing organisms as judged by the production of H₂S under anaerobic condition. The sulphate-reducing organism in the Cutch soils was isolated and found to be a rod-shaped motile spore former, differing in many respects from the organisms described by other workers. A detailed study of this organism and its role in soil development processes will be published elsewhere.

K. V. S. SATYANARAYANA.
S. C. DATTA.

Indian Agric. Res. Inst.,
New Delhi,
March 17, 1953.

1. Datta, S. C., *Curr. Sci.*, 1943, **12**, 305. 2. —, *J. Sci. Indust. Res.*, 1946, **5B**, 28. 3. Iya, K. K. and Sreenivasaya, M., *Curr. Sci.*, 1945, **14**, 243, 267. 4. Satyanarayana, K. V. S., *Ind. Soc. Soil. Sci. Bull.*, 1951, No. 6, 125.

SYNTHESIS OF PECTIC SUBSTANCES IN THE POST-HARVEST CONDITION OF PEARS

WITH the abscission of fruit from the tree, the metabolism of fruits is more of the catabolic type, especially if the fruit has passed its climacteric stage. However, changes in certain chemical constituents of the fruits have been observed to be of the anabolic type. Carre¹ has shown in her work on storage of apples that the total pectin content of apples tends to increase as the fruits ripen. Haller's² studies show similar trends. Heinze and Appleman³ found that in sweet potatoes protopectin increased, while pectin decreased during the storage period. The increase in protopectin was partly due to an increase in the total pectic substances. Data from other sources^{4,5} show that the concentration of sucrose and protein increases during storage of deciduous fruits.

As a part of the cold storage investigations on three varieties of pears, pectic changes during

the full storage period were studied at monthly intervals. Estimation of pectic substances was done according to the method of Carre.⁶ The results of these studies are given in Table I. The results show that the amounts of both protopectin and total pectin increased during storage in all these three varieties suggesting that the pectic substances are synthesized during the post-climacteric period. Complete data on the pectic changes during storage at 30°-31° F. and periodical ripening at 68°-70° F. are being reported elsewhere.

TABLE I

Pectic changes in pears during cold storage

Pectic material weighed as calcium pectate and expressed as per cent. of fresh weight

| Variety | Month | Pectin | Control Room | Air Filtered Room* | |
|-----------------|----------|--------|--------------|--------------------|-------------|
| | | | protopectin | Pectin | Protopectin |
| <i>Bartlett</i> | October | 0.307 | 0.377 | 0.216 | 0.529 |
| | November | .202 | .509 | .210 | .490 |
| | December | .237 | .651 | .282 | .620 |
| | January | .257 | .425 | .310 | .484 |
| | February | .216 | .481 | .159 | .444 |
| <i>Bosc</i> | October | 0.207 | 0.381 | 0.209 | 0.373 |
| | November | .291 | .399 | .248 | .405 |
| | December | .221 | .480 | .225 | .432 |
| | January | .157 | .559 | .193 | .555 |
| | February | .222 | .543 | .219 | .519 |
| <i>Anjou</i> | October | 0.296 | 0.473 | 0.169 | 0.528 |
| | November | .202 | .431 | .254 | .469 |
| | December | .172 | .690 | .184 | .646 |
| | January | .191 | .742 | .181 | .677 |
| | February | .232 | .473 | .118 | .630 |
| | March | .361 | .448 | .208 | .569 |

* This room was fitted up with a Dorex Unit to filter ethylene from the storage atmosphere.

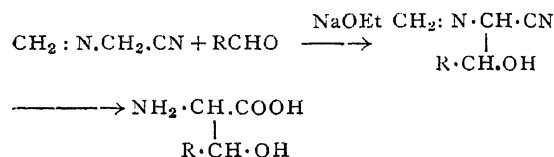
Dept. of Horticulture, W. B. DATE.†
Oregon State College, ELMER HANSEN.
Corvallis Oreg., U.S.A.,
March 3, 1953.

† Present Address Central Food Technological Research Institute, Mysore.

1. Carre, M. H., *Bioch. Jour.*, 1922, **16**, 704-12. 2. —, *Ibid.*, 1922, **16**, 60-69. 3. Haller, M. H., *Jour. Agri. Res.*, 1929, **39**, 730-46. 4. Heinze, P. H., et al., *Plant Physio.*, 1943, **18**, 548-55. 5. Hulme, A. C., *D. S. I. R. Food Inv. Board Report for 1933, 1934*, 70-71. 6. Kidd, F., et al., *Ibid.*, 1938, 1939, 119-25.

A NEW METHOD FOR THE SYNTHESIS OF AMINO-ACIDS AND RELATED COMPOUNDS

METHYLENE amino aceto nitrile,^{1,2} has been found to be a convenient starting material for the synthesis of amino acids. It has been condensed with aliphatic and aromatic aldehydes in presence of sodium ethoxide when it was found to give aldol condensation products in good yields. These, on hydrolysis with hydrochloric acid, yielded the corresponding amino acids.



3.4 g. of methylene amino aceto nitrile with paraformaldehyde (7 g.) in presence of sodium ethoxide from sodium (1.15 g.) gave 2.5 g. of the intermediate aldol, whence 2.0 g. of serine was obtained after hydrolysis. Similarly, 3.4 g. of methylene amino aceto nitrile gave with paraldehyde (7.0 g.) and sodium ethoxide from sodium (1.15 g.), 3.0 g. of the intermediate and 2.5 g. of the amino acid. The yields from anisaldehyde and piperonal were 3.5 g. of the intermediate in the case of the former and 4.0 g. in the case of the latter using 3.4 g. of methylene amino aceto nitrile. The yields of the respective amino acids were 2.3 g. and 3.7 g.

The table below gives the melting points of the intermediate and final products.

| Starting substance | Intermediate aldol m.p. °C. | Amino acid m.p. °C. |
|--------------------|--------------------------------|-------------------------------|
| Paraformaldehyde | 62-64 | 246 (decomp.) serine |
| Paraldehyde | .. | 228-29 (decomp.) Threonine |
| p-Anisaldehyde | 125-26 | 155 |
| Piperonal | 218-20 | 125-27 |

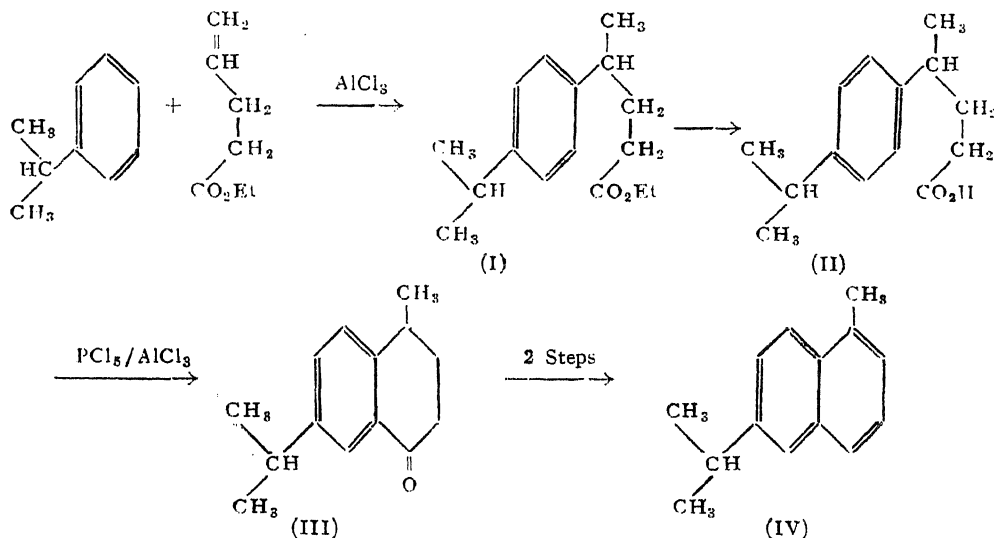
Further work is in progress and will be published elsewhere.

Organic Chemistry Dept., P. B. MAHAJANI.
Institute of Science, J. N. RAY.
Bombay,
March 19, 1953.

1. Klages, *Ber.*, 1903, **36**, 1506. 2. Hantzsch and Silbered, *Ibid.*, 1900, **33**, 70.

FRIEDEL-CRAFTS REACTION
BETWEEN ETHYL ALLYLACETATE
AND CUMENE

In an earlier communication¹ we reported the aluminium chloride-catalysed condensation between toluene and ethyl allylacetate and the meta orientation in the resulting product was unequivocally established. The meta orientation in the case of toluene prompted us to study aluminium chloride-catalysed reaction between cumene and ethyl allylacetate which was expected by analogy to give rise to ethyl γ -(*m*-cumyl)-valerate, an important intermediate in the synthesis of eudalene. In view of a recent article by Chaudhuri,² we place on record the results so far obtained in this regard.



Cumene and ethyl allylacetate were subjected to aluminium chloride-catalysed reaction at 0-5° when *inter alia* the ester (I) was obtained in satisfactory yield, b.p. 160°/10 mm. The ester (I) on hydrolysis with ethanolic caustic potash gave the corresponding acid (II), b.p. 164°/5 mm. [lit. (4) records for γ -(*p*-cumyl)-valeric acid, b.p. 190°-91°/10 mm.], *s*-benzyl-isothiuronium salt, m.p. 125° (Calc. for C₂₂H₃₀O₂N₂S : N, 7.25; Found : N, 7.49). Cyclisation of the above acid (II) was effected by Johnson's inverse cyclisation process³ to afford the ketone (III), b.p. 146°/10 mm.; 2, 4-dinitrophenyl-hydrazone, m.p. 146°-47° (Calc. for C₂₀H₂₂O₄N₄ : N, 14.65; Found : N, 14.50); semicarbazone, m.p. 175°-76° decomp. [lit. (4) records for semicarbazone of 4-methyl-7-isopropyl-1-tetralone, m.p. 175°-76° decomp.], (Calculated for C₁₈H₂₂ON₃ : N, 16.21; Found : N, 16.60). It appears, there-

fore, that the fraction (I) is *para*-orientated. However, the ketone (III) was reduced (Clemmensen) and the reduced product dehydrogenated with sulphur to 1-methyl-6-isopropyl-naphthalene (IV), b.p. 130°/8 mm.; picrate, orange-red needles from ethanol, m.p. 148°. The Friedel-Crafts condensation product consisted of other fractions in addition to (I). These fractions are being studied.

Microanalyses by Drs. Weiler and Strauss, Oxford.

Dept. of Chemistry,
Panjab University,
Hoshiarpur,

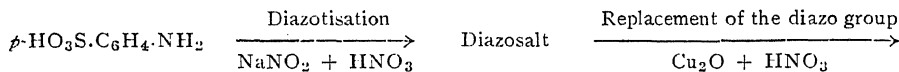
N. K. MAHESHWARY.
O. P. VIG.
S. M. MUKHERJI.

March 24, 1953.

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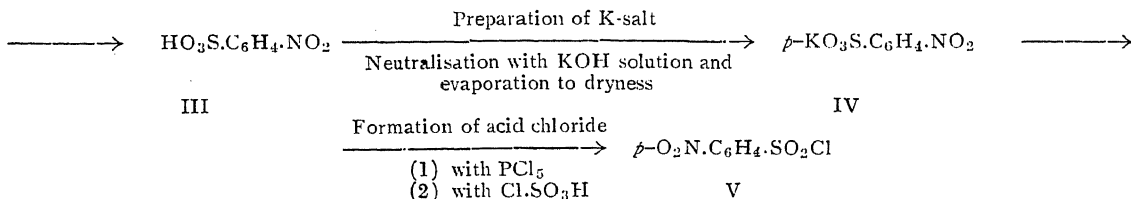
A NEW SYNTHESIS OF *p*-NITRO-
BENZENE SULFONYL CHLORIDE

THOUGH methods of preparation¹⁻⁶ of this compound are to be found in literature, the product got from these is not pure as it is contaminated with large amounts of impurities [like bis (*p*-nitrophenyl) sulfoxide, bis (*p*-nitrophenyl) sulphone and *p*-nitrobenzene sulphenyl chloride] which make purification of the sulphonyl chloride difficult. Complete purification could not be effected by crystallisation. Distillation of the compound results



I

II



in explosion even if carried out with utmost care.

A new method of synthesis of *p*-nitrobenzene sulphonyl chloride which obviates all the aforementioned difficulties and yields the pure compound has now been carried out starting from sulphanilic acid and following the sequence of reactions indicated above.

Sulphanilic acid was diazotised and the diazo salt treated with cuprous oxide and dilute nitric acid in order to replace the diazonium group by nitro group. The resulting *p*-nitrobenzene sulphonic acid was converted into the potassium salt. The dry potassium salt on treatment with phosphorous pentachloride gave *p*-nitrobenzene sulphonyl chloride melting at 78-79° C. Full details of this method of preparation will be published elsewhere.

Our thanks are due to Dr. B. H. Iyer for his keen interest during the course of this investigation.

Dept. of Organic Chemistry, K. RAMAN.
Indian Institute of Science, M. RAGHAVAN.
Bangalore-3,
March 25, 1953.

1. Obermiller, *J. prakt. Chem.*, 1914, **89** (2), 84.
2. Ekblom, *Ber.*, 1902, **35**, 653; Blanksma, *Rec. Trav. Chim.*, 1901, **20**, 129. 3. Alber, *J. Franklin Inst.*, 1939, **228**, 127. 4. Witte, *Rec. Trav. Chim.*, 1932, **51**, 299. 5. Bell, *J. Chem. Soc.*, 1928, 2770. 6. Barber, *Ibid.*, 1943, 101-4.

SUBSTITUTES FOR THE ZIMMERMANN-REINHARDT REAGENT

THE use of the Zimmermann-Reinhardt reagent in the permanganometric titration of ferrous iron in hydrochloric acid is well known.

It has been found that addition of either sodium acetate or borax instead of the above reagent in the titration yielded results precisely similar to it.

Using decinormal solutions of ferrous ammonium sulphate and potassium permanganate, in presence of 5N hydrochloric acid, either with 30 ml. of the Zimmermann-Reinhardt reagent prepared in the usual way or with a pinch of crystalline sodium acetate or a small quantity of not less than 0.2 g. of borax, an aliquot part of ferrous solution required the same volume of permanganate solution for titration.

Varying the amount of sodium acetate from 2 g. to 6 g. and borax from 0.4 g. to 1.6 g. did not influence the amount of permanganate required for titration. An insufficient quantity of the acetate below 2 g. or of borax below 0.4 g. required slightly higher quantity of the oxidising agent.

Our investigations have shown that if only more than either 2 g. of sodium acetate or 0.4 g. of borax are added, instead of the Zimmermann-Reinhardt reagent, the purpose is very well served. The advantage of using these new substitutes consists in their cheapness, ready availability and ease of preparation compared with the older one, one of whose constituents is the costly syrupy phosphoric acid.

The change in colour at the end-point, either with the sodium acetate or borax was as sharp as in the case of methyl orange, the change from yellow to orange red lasting for not less than 1½ minutes unlike with the Zimmermann-Reinhardt reagent wherein the pink colour does not last for more than ½ minute.

In an extensive investigation on the mechanism of action of the Zimmermann-Reinhardt reagent or sodium acetate, we have observed that the pH, as determined by the Cambridge pH meter using a gold electrode with quinhydrone in the solution and a saturated calomel electrode in conjunction, goes on varying slightly with the progress of the titration and remains more or less constant at the end-point, unlike with hydrochloric acid done without any of these reagents, when it is found to fluctuate.

A study of the oxidation potentials of the whole system during the permanganometric titration of ferrous iron in presence of hydrochloric acid has also been made. It is found that without the addition of any one of the reagents in hydrochloric acid solution, there is a fluctuation of the oxidation potential all through the titration as could be seen in the unsteadiness of the pointer in the Cambridge Potentiometer. When either the Zimmermann-Reinhardt reagent or sodium acetate is present, a steady reading could be got after the addition of every ml. of permanganate solution up to the end point, after which there was inconsistency again.

Also, it has been observed that addition of sodium acetate halfway in the titration has a steadying effect on the oxidation potential of the system.

Details of the investigation will be published elsewhere.

Chemical Labs., C. V. SURYANARAYANA.
Annamalai University, K. M. SOMASUNDARAM.
Annamalai Nagar,
April 1, 1953.

NEUROSECRETION IN *IPHITA* *LIMBATA* STAL.

SCHARRER^{1,2} AND HANSTROM³ have pointed out that the neurosecretory cells of the insect brain situated in the pars intercerebralis, form secretory products having endocrine function and that these pass through the nervi corpora cardiaca to reach the corpora cardiaca which act as reservoirs for the neurosecretory material. Thomsen⁴ suggests that the medial neurosecretory cells possess an over-all control of the endocrine system of insects.

Using the chrome-haematoxylin-phloxin staining method after Gomori, which selectively stains the neuroglandular cells of the brain, it was seen in the bug *Iphita limbata* Stal. (?) (*Pyrrhocoridae: Hemiptera heteroptera*) that there is a set of giant cells in the pars intercerebralis of the brain, which are secretory. These cells are the medial neurosecretory cells (Fig. 1). They contain in their cytoplasm a dense mass of blue-black granules forming the secretion product which stands out against the red of the nervous tissue stained by phloxin. The blue-black of these cells is traceable in sections of the corpora cardiaca, which are small, paired and rounded organs lying in close contact with the brain.

The neurosecretory cells of the pars intercerebralis show a dense mass of Gomori-

positive granules in the newly moulted, mating and gravid females. They are less dense in nymphal instars, and after oviposition. Such cells with Gomori-positive granules are found in the thoracic ganglia also.



FIG. 1. Median Neurosecretory cells of brain of *Iphita limbata*—Six cells with the secretion stained blue (dark) are seen in the pars intercerebralis Gomori, technique.

The cytology and physiology of these neuroglandular cells and the pars intercerebralis-cardiacum-allatum system of the insect are under investigation and the results will soon be published elsewhere. It is interesting to note that this system of the insect has been compared to the hypothalamo-hypophyseal system of the vertebrates and the X organ sinus gland system of the crustaceans.

Zoology Laboratories, K. K. NAYAR.
University College, Trivandrum,
March 26, 1953.

1. Scharrer, B., *Anat. Rec.*, 1951, **111**, 554. 2. —, *Biol. Bull.*, 1952, **102**, 261. 3. Hanstrom, B., *Nature*, 1953, **171**, 72. 4. Thomsen, E., *J. Exp. Biol.*, 1952, **29**, 137.

PHYTOPHTHORA CYPERI-BULBOSI, SP. NOV. ON *CYPERUS BULBOSUS* VAHL.

Soon after the rains in October 1952, a leaf blight of *Cyperus bulbosus* was prevalent in Coimbatore. One or more isolated brown lesions appeared on the leaves, later followed by the withering of the leaves. Eventually, the

infection spread to other leaves and the aerial shoots dried up. The disease was caused by a species of *Phytophthora*. Both sporangia and oospores were produced on the host plant. The former developed on stalks emerging through the stomata. The oospores were formed in the tissues of the leaf-blade and sheath.

All attempts to grow the fungus on the agar media usually used for cultures of *Phytophthora* failed. Infection experiments were conducted using sporangia produced on the host leaves. Typical lesions were produced on the third day on the leaves of *C. bulbosus*.

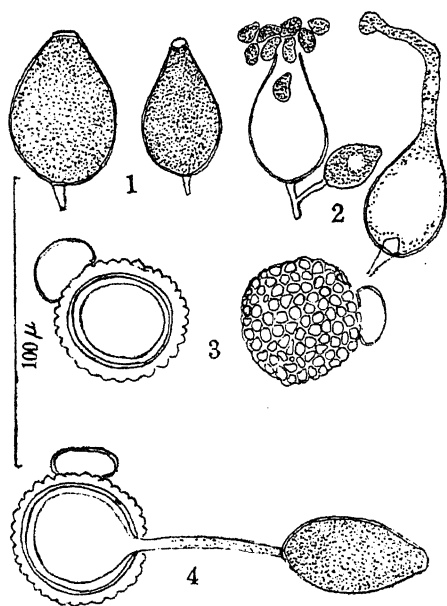


FIG. 1. Sporangia, 2. Germinating sporangia, 3. Oospores (sectional and surface views), 4. Germinating oospore.

Phytophthora cyperi-rotundati Saw.¹ has been reported on *C. rotundus* from Formosa. The fungus under study exhibits affinity to this fungus but differs from it, in its inability to infect *C. rotundus* and in the possession of tuberculate oogonia. Furthermore, the antheridia are all paragynous, while in *P. cyperi-rotundati* they are amphigynous or paragynous. On account of these differences, it is described as a new species under the name, *P. cyperi-bulbosi*.

Phytophthora cyperi-bulbosi, sp. nov.

Maculae irregulares, indefinitae, brunneae, amphigenae; hyphae intercellulares, ramosae; sporangiophori emergentes per stomata, haud ramosi, vel sympodiae ramosi, tenues; sporangia

obpyriformia, papilla lata, $40 \times 25 \mu$ ($23-50 \times 20-34$), germinantia per productionem zoosporarum vel tuborum germinationis; oogonia efformantur in cavitatibus aeries in vagina foliorum, sphaerica, reticulata, parietibus crassis, fusce brunnea, 40μ ($31-53$) diam.; oosporae fere implentes oogonium, sphaericae, levibus parietibus ornatae, brunneae 33μ ($25-42$) diam.; antheridium ut plurimum unum in singulis oogoniis, paragynum $16 \times 12 \mu$ hyalinum; oosporae germinantes in maturitate, producentes unum sporangium in apice tubuli germinationis.

On living leaves and leaf-sheath of *Cyperus bulbosus* Vahl. (Cyperaceae), Coimbatore, 10-11-1952, Kumari V. Seethalakshmi.

We are indebted to Dr. H. Santhapau for the Latin translation.

Agric. Col. & Res. Inst., V. SEETHALAKSHMI.
Lawley Road, P.O., T. S. RAMAKRISHNAN.
Coimbatore,
December 18, 1952.

1. Ito, S., et Tokunaga, Y., *Trans. Sapporo Nai. Hist. Soc.*, 14, 14.

MORPHOLOGY OF THE SPOROCARP IN THE MARSILEACEAE

THE morphological nature of the sporocarp of Marsileaceae has long remained controversial. While it is generally agreed that it is a foliar structure, opinion is sharply divided as to the number, structure and nature of segments entering into its composition. None of the existing views seems to stand a critical examination.

During the course of our study of the anatomy of the sporocarp of *Marsilea minuta* L., though nothing strikingly different from what has already been described could be observed, it was nevertheless realized that in the vascular plan of the sporocarp there are features whose significance has not been fully appreciated so far. A brief account of these may be helpful at this stage.

Each sporocarp receives one median bundle which, towards the distal end, splits up into two branches. From this, about ten commissural bundles are set off alternately on each side (Fig. 1). They encircle down the wall of the sporocarp and break up into three branches each after traversing about one-third of their total distance. The two outer bundles diverge sideways into the inter-soral area of the wall of the sporocarp. In the lower region, each of these fuses with a corresponding branch from the adjoining commissural bundle. The third

branch diverges inward and supplies the sorus which occurs in the plane of the commissural bundle. Just before bending down, it gives off a small branch for the upward extension of the sorus in the opposite direction (Fig. 1).

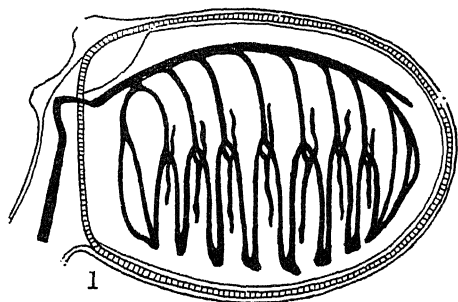


FIG. 1. Diagrammatic representation of vascular plan of one half of the sporocarp of *M. minuta* as seen from inside. Thick lines denote vascular bundles.

We believe that these anatomical features are of special interest in reading the past history of the sporocarp.

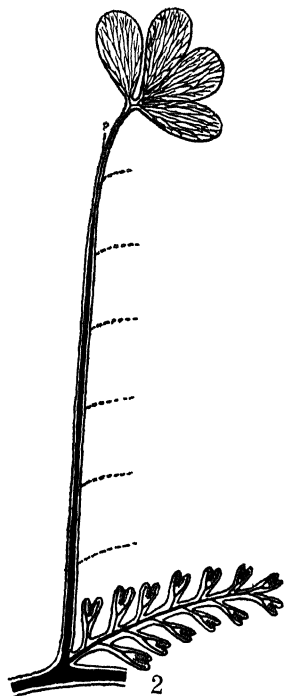


FIG. 2. Schematic representation of the authors' conception of a primitive leaf of *Marsilea*. The lowest leaflet is fertile with lobed pinnules. It is believed that the present-day sporocarp is obtained from such a leaflet by fusion and enfolding of its pinnules.

It is generally agreed that the primitive leaf of the Marsileaceae had many leaflets, all

arranged on one side^{1,2} on an anadromic helioid plan such as is seen in the leaf of *Pteris semipinnata*. Generally, two of these have survived, the lowest forming the sporocarp and the uppermost developing into vegetative segments (whether these vegetative segments are leaflets or pinnules is discussed in the fuller account elsewhere). The suggestion made by some authors that sporocarp consists of two or four leaflets is, therefore, based on misconception (see Fig. 2). It must always be equivalent to a single leaflet.

The past history of the fertile leaflet (sporocarp), however, has been most controversial. We think it is very clearly illustrated in the vascular plan of the sporocarp. Each fertile leaflet consisted of as many pinnules as the number of commissural bundles, the latter forming the mid-rib bundles of the former. Every pinnule was bilobed and bore sporangia on the inner margins of its lobes (Fig. 2). In course of evolution, all the lobes and pinnules fused together and all the sporangia stood up borne on a ridge, the placental ridge, which perhaps secondarily extended upward beyond the point of origin of the placental bundle. That this may have been so is borne out by the condition in the less specialized *Regnellidium* where there is no such extension.³ Ultimately, the enfolding and subsequent fusion of the lamina resulted in a globular sporocarp. That such has been the course of events in the evolution of this complex fruiting body seems to be clearly indicated by the behaviour of the commissural bundles and their branches. The bilobed condition of the fertile pinnules, which is suggested by the forking of the commissural bundles and which is an essential feature of the interpretation put forward here, offers a satisfactory explanation of the location of the sorus opposite to the mid-rib bundle of the pinnule. This fact has not been adequately explained in any of the interpretations so far suggested.

The direction of the folding of the pinnules, whether abaxial or adaxial, has also been very controversial.² We have observed that the main bundle in the rachis, peduncle and the sporocarp is more or less V-shaped with the concavity on the adaxial side. Since in the sporocarp this concavity is on the inner side, it is concluded that the folding is adaxial.

Thus, there are three important features which are brought to light by the present study: (1) the pinnate nature of the single fertile leaflet which forms the sporocarp, (2) the bilobed nature of the fertile pinnules,

and (3) the adaxial folding of the pinnules. All these are of special value for a thorough understanding of the morphology of the sporocarp in the Marsileaceae.

Dept. of Botany, V. PURI.
Meerut College, MAN MOHAN LAL GARG.
Meerut, India,
January 9, 1953.

1. Bower, F. O., *The Ferns* II, 1226. 2. Eames, A. J., *Morphology of Vascular Plants, Lower Groups*, 1936. 3. Johnson, D. S. and Chrysler, M. A., *Amer. J. Bot.*, 1938, 25, 141-56.

INFLUENCE OF DEPTH OF FURROWS IN THE IRRIGATION OF POTATOES

THE experiment was conducted to find out under Delhi conditions, the optimum amount of water required to mature the potato crop and give the most economic return of tubers. The treatments were (1) Irrigation : 5, 7 & 9 each of 3" depth. (2) Depth of furrows 4½", 6" and 9". (3) Nitrogenous fertilizers 40, 80 and 120 lb. N/acre. The layout was of 3 × 3 × 3 partially confounded design with two replications having 3 blocks in each. Each block had 9 plots and each plot was of 24' × 15', i.e., 1/121 acre in area. 2' border was kept between the plots. Irrigation water was measured with a 90° notch. The rainfall was 4.56" spread over the growing season. There was no run off. The water table fluctuated between 15' and 11' from the surface. The variety of potato was *Phulwa*.

Statistical analysis of the results showed that the differences in yield due to treatments of irrigation and depths of furrows were significant at 1% level. In irrigation treatments there was practically no difference in yield with 21" and 27" of water but both were significantly superior to the yield obtained with 15" of water showing thereby that 21" was the optimum dose. The increase in yield due to 6" deep furrows was significantly greater at 1% level over that due to 4½" deep furrow and at 5% level over that due to 9" deep furrows. The 9" deep furrows had given significant increases in yield over that due to 4½" deep furrows at 5% level. The yield of tubers obtained with 80 lb. N/acre was greater than that obtained with 40 or 120 lb. N/acre. 6" deep furrows in combination with 21" of water or 80 lb. N/acre gave the optimum yield.

Ind. Agric. Res. Inst.,
New Delhi,
February 16, 1953.

N. P. DATTA.
B. B. BOSE.

AN UNDESCRIBED SPECIES OF SYNCHYTRIUM ON AMPELOCISSUS LATIFOLIA

ON *Ampelocissus latifolia* Planch., a member of the Vitaceae, a *Synchytrium* species was collected from several places in Bihar, which on examination was found to be undescribed. On the leaves the infection appeared as tiny yellowish minute galls, which often were grouped together in close proximity and presented a scabby appearance. On stems the galls were minute and imparted a warty appearance to the infected regions.

Sections through the galls on leaves and stems indicated the presence of resting spores only and the prosorus and sporangia were absent. The galls were single with a large reddish-brown resting spore in each. The epidermal host cells surrounding the infected epidermal cell multiplied rapidly and produced a mass of hyperplastic tissue which surrounded the gall. Consequently in the sections through the gall, the resting spore was seen embedded in a small mound of hyaline cells. In old galls the resting spores dropped off leaving a large concavity in the centre.

Comparative studies indicated that it differs from other species of *Synchytrium* known on Vitaceae and related families.

Synchytrium ampelocissi Mishra sp. nov.

Inciting gall formation on leaves and stems; galls minute, golden yellow, often grouped together and presenting a scabby appearance, simple and distinct. Resting spores globoid to subspherical, golden-brown, thick-walled with oil globules surrounded by a mound of thin-walled tissue, 2 to 3 layers at top and 2 to 4 layers on the sides, measuring 110.4 to 220.8 μ average 141.4 μ in diameter.

Hab. On leaves and stems of *Ampelocissus latifolia* Planch., Darbhanga, Bihar, 7-12-1952, leg. J. N. Mishra. Type deposited in Herb. Crypt. Ind. Orient., New Delhi.

Grateful thanks are due to Dr. M. J. Thirumalachar for his kind help in identification of the fungus and preparation of the manuscript.

Div. of Plant Pathology J. N. MISHRA.
and Mycology,

Bihar Agric. Res. Inst., Sabour,
Bhagalpur,
February 13, 1953.

EGG-YOLK FACTOR AS BUFFALO SEMEN DILUTOR

It has been shown that the fertilizing capacity or the motility of buffalo spermatozoa cannot

be retained on an average for more than 48-72 hours in either egg-yolk phosphate or citrate buffer dilutors, which have proved so useful and popular for *Bos taurus* and *Bos indicus* semen. This has been a limiting factor in the wider application of artificial insemination in buffalo.

Experiments recently started with the active principle¹ present in egg-yolk have given encouraging results. The active principle was isolated by first precipitating proteins in egg-yolk with the addition of 4 vols. of acetone and subsequent washing with acetone to remove the greater proportions of the lipids. The yellowish precipitate was dried *in vacuo* to remove acetone, then extracted with Sorensen's buffer system— $\text{Na}_2\text{HPO}_4 + \text{KH}_2\text{PO}_4$ (pH 7.4) and followed by filtration or centrifuging of the buffer extract to remove insoluble material.

Fifteen good quality ejaculates from eight different buffalo bulls, belonging to a breed indigenous to Uttar Pradesh, were preserved at 4° C. in the solution of the active principle in the ratio of 1:1. Samples taken from the same ejaculates and kept in egg-yolk phosphate buffer dilutors served as controls. In the majority of cases, two samples of each ejaculate were preserved in each dilutor. In the controls no sperm survived beyond 12 days while in the samples preserved in the active principle live sperm were present upto 21 days. Further, in the former, out of 14 ejaculates, 5 could not be used for artificial insemination after 24 hours, 8 after 96 hours and 1 after 144 hours (having motility rating less than +++); while in the latter, 5 could be used upto 192 hours, 1 upto 240 hours, 5 upto 288 hours and 1 upto 336 hours. Only in two samples kept in the active principle was no live sperm present after 96 hours. It was also observed that the trace of lipo-protein was essential to prevent spermatozoa from the temperature shocks.² These results show that the life of the buffalo sperm *in vitro* could be extended for periods upto 2 to 3 times through the use of only the active principle in egg-yolk instead of egg-yolk itself in the dilutor. Further work is in progress.

Division of Animal Genetics, P. N. SRIVASTAVA.
Indian Veterinary Res. Inst., S. S. PRABHU.
Izatnagar, P. BHATTACHARYA.
March 10, 1953.

'CREEPING' A MUTANT IN CAJANUS CAJAN MILLSP.

DURING the course of botanical improvement work on tur at the Agricultural Research Station, Niphad (Nasik), two unusual plants having abnormal structure and distinctly different as compared to the normal tur plants, were observed in the F-3 progeny of a cross between T. 74 and T. 43. These plants arose spontaneously and are breeding true for the last six years.

The normal tur plants grow erect, giving lateral, erect branching of indefinite or racemose type. None of the branches in normal tur plants is prostrate.



Newly observed plants have a weak stem as well as branches and hence put forth all its lateral branches close to the ground which results in a prostrate habit of growth. Because of the peculiar growth habit associated with this character, they have been named *Creeping*.

The creeping character had not been observed in either of the parental lines. Creeping plants are indistinguishable from the normal plants up to the time that the stem begins to elongate rapidly. Under ordinary field conditions the plants are about 1½' in height and 1½ to 2 months age at this time. As the stem and branches elongate, they lack sufficient strength to hold the plant erect and branches spread flat on the ground.

The prostrate habit is likely to be found useful as a cover crop and would help in soil conservation in the dry regions and in strip cropping.

The detailed genetical behaviour of these plants are under study and will be published later. Histology of stem of these plants is also being studied.

Agricultural Res. Station, B. B. CHAUDHARI.
Niphad (Nasik), J. A. PATIL,
February 11, 1953,

1. Mayer, D. T. and John, F. Lasley, *Jour. of Animal Science*, 1945, 4, 277. 2. Kampschmidt, R. F. and Mayer, D. T., *Abs. Jour. of Animal Science*, 1951, 10, 1077.

REVIEWS

Astronomy for Everyman. Edited by Martin Davidson. (Dent & Sons., London), 1953. Pp. 512. Price 18 sh. net.

This is an up-to-date and authoritative summary of astronomical knowledge and of the methods used in acquiring the same. Besides the introduction which gives a general survey of the universe by the editor, there are 12 chapters, each written by an expert in the field—usually the Director of the Corresponding Section in the British Astronomical Association. Of these, five are devoted to the solar system, while the others deal with comets and meteors, the aurora and zodiacal light, the stars, light and instruments, history of astronomy, navigation, and the road to the planets (interplanetary flight). The treatment is popular, and mathematics has been avoided except in footnotes and appendices, and in the chapter on navigation which is intended for the special reader. There are nearly 160 figures and 40 photographic plates to illustrate the wealth of material which has been condensed into this excellent book. Among the latest advances in astronomy which find a reference in the book are the study of shortwave electromagnetic radiation from various sources, not only in the Milky Way region, but also elsewhere, new optical instruments in use in the solar observatory, the detection of meteors (which usually leave an electron trail behind them) by means of radar—a method which can be used also in daylight and has enabled streams coming from the direction of the sun to be detected. In the historical chapter, there are references to the astronomical discoveries of the Egyptians, the Chinese, the Babylonians and to Muslim Astronomy, but references to India's astronomical contributions are conspicuous by their absence.

A. NARASINGA RAO.

Theory of Electric Polarisation. By Dr. C. J. F. Bottcher. (Elsevier Publishing Company), 1952. (Distributors: Elsevier Hume Press Ltd., London). Pp. xii + 492. Price 70 sh.

This book gives a nearly complete survey of the theory of electric polarisation and related subjects for the use of both physicists and physical chemists. Much attention is paid to fundamental concepts and the reader is expected to be familiar with the basic principles of electrostatics and vector calculus. Four appen-

dices on such mathematical subjects as the Legendre functions, and the Laplace operator have also been added. The introductory chapters deal with the definitions of fields of an ideal and a non-ideal dipole and with the fundamental concepts and problems of electrostatics such as the vectors E and D , the polarisation P and polarisability α . The reaction field of a dipole is discussed in Chapter III while in Chapter IV, multipoles are discussed. In Chapter V, the various types of problems relating to polarisation and energy in a dielectric medium are discussed. Included in this chapter is a discussion on the contribution of the permanent dipoles to the cohesion energy in a fluid.

The important problem of a dielectric placed in a uniform external field is the subject-matter of Chapter VI. In the various discussions of the effective value of the external field, no reference has been made to the theory originally developed by Raman and Krishnan in 1927 for pure liquids with anisotropic molecules and later extended to the case of mixtures of dielectrics. In Chapter IX on the determination of permanent dipole moments, the several methods of measurement and computation developed hitherto have been dealt with critically, together with a brief discussion on the relation between dipole moments and molecular structure. The next chapter deals with the subjects of polarisation at high frequencies and the factors of loss angle and relaxation time. The last chapter deals with the polarisation of solids.

Taken as a whole, the book provides a comprehensive and critical account of the current theories of dielectric polarisation and is in itself a valuable addition to the contributions to the subject. The book has been clearly printed and got-up in a pleasant readable form and must be considered as a distinct success in the art of book production. M. A. G. R.

Gravity Waves. Edited by A. V. Austin, Director, National Bureau of Standards, U.S. Dept. of Commerce. (N.B.S. Circular 521, November 28, 1952). (Supdt. of Documents, U.S. Govt. Printing Office, Washington). Pp. iv + 287. Price \$1.75.

This volume comprising the proceedings of the N.B.S. Semi-Centennial Symposium on

Gravity Waves held at the N.B.S., June 18-20, 1951, covers a wide range of experimental and theoretical results in the study of gravity waves in U.S. and European laboratories. There are 33 papers by different authors of which 7 are in abstract only. In addition to study of sea-waves, their refraction, diffraction and breaking at harbours and breakwaters, the contributions also include papers on sub-surface flow, on atmospheric tides and on motion of water due to breaking of a dam.

Two papers, one on discrete and continuous spectra by Ursell and one on Fourier Analysis of wave trains by Birkhoff and Kolik analyse some of the characteristics of complete wave forms. There is a number of papers on the growth of complex sea-waves, of which Neumann's observations in the North Atlantic area can be specially mentioned. The progress of waves over sloping beaches as well as their breaking are also described, and excellent details of particle movement in a breaking wave are reported by Iversen from Berkeley and Mason from the Beach Erosion Board. Some recent work on wave, and seiches is reported by McKnown, and an article on tides in an enclosed basin by Zerbe describes the derivation of earth movement from observations in the David Taylor Model Basin. On measurement techniques, mention may be made of the stereophotogrammetric waves measurements by Schumacher, and the laboratory methods used at Chatou, France.

This excellent contribution on the latest researches is commended to the technical and research workers in the subject, as a valuable bridge between the purely engineering applications of gravity waves and their treatment in terms of the hydrodynamics of the classical school.

S. K. ROY.

The Cathode Ray Oscillograph in Industry. By W. Wilson. Fourth Edition. (Chapman & Hall Ltd., London), 1953. Pp. 273. Price 36 sh.

The book under review covers a very important theme which has been discussed only partly in few existing books on the general application of oscillographs. The demand for such a book is no doubt high.

According to the preface, the author has intended, bearing in mind the interests of users, to deal with all kinds of cathode ray oscillographs, their construction, functioning and application. It would have been enough if the author had concentrated strictly on this theme. Instead, he has included short descriptions of

some kind of electron tubes, related devices and equipment which have been sufficiently described in available technical literature. This is especially applicable to Chapter XI, which describes the electron microscope and its applications—a subject on which there are special books.

The description of the working principles of cathode ray tubes, their parts and equipment, is too meagre for those who are unacquainted with electronic technique. The photographs of some cathode ray tubes and their parts do not give a clear impression about them and could be replaced by drawings to better advantage. The description of different types of oscillographs consists only of short explanations for a series of photographs and one complete diagram of a miniature oscillograph. The special Chapter XII: "Construction, Operation and Maintenance" contains very little in spite of its importance. The contents of the book require replenishing and completion. Some small discrepancies which cannot be mentioned in this short review, should also be rectified.

The positive feature of this book includes a review of the application of oscillographs with glass and metal cathode ray tubes for different technical tests given in Chapters V-X, illustrated with reproductions of the photographs from the oscillograph screen taken during the different tests. The directions regarding the operation of metal oscillographs given in the book are very useful.

References are given throughout the text, but it would be desirable to increase their number and collect them in a list at the end of the book.

The book will be useful for the technician, scientist and students having already some experience with electronic equipment, also as a reference book for the application of oscillographs for different technical tests.

A. SUSZKIN.

Colloid Science. Vol. I (Irreversible Systems). Edited by H. R. Kruyt. (Elsevier Publishing Company, Amsterdam), 1952. Pp. 368. Price 70 sh.

The treatment of the subject in this book is monographic in nature and is designed to serve the needs of research workers already in the field or those who desire to familiarise themselves with certain advancing trends in colloid science. It is based on a new classification of colloids into reversible and irreversible systems, i.e., colloid systems which can undergo phase separation reversibly or otherwise. Besides the

editor, G. H. Jonker and J. Th. G. Overbeck have made contributions to this volume.

The first chapter by Kruyt deals with the classification of colloid systems based on the size of the mono-molecular particle, states of aggregation and thermodynamics of colloid solutions. The physical, chemical and optical properties have been discussed in an elegant fashion. Overbeck described the preparation, peptization and purification of lyophobic sols both in aqueous and non-aqueous media in the second chapter. 'Optical Properties of Colloidal Solutions' by Jonker in the following chapters comprises an illuminating exposition of Tyndall effect, the theory of Raleigh and fluctuations on the scattering of light by spherical as well as non-spherical particles. The succeeding six chapters contributed by Overbeck constitute an admirable survey on the structure and kind of double layers, determination of zero-point charges and the Donnan equilibrium.

The chapter on electrokinetic phenomena will prove valuable to the colloid physical chemist, for, it touches the latest trends in electro-osmosis, streaming and migration potentials. The treatment of electrophoresis is as exhaustive as it is brief from every point of view. Interactions between colloidal particles leading to attractive and repulsive forces in the double layer have been thoroughly analysed. The last chapter on the rheology of lyophobic system contains an exhaustive survey on viscosity, dilatancy, influence of external agents on gel formation and plasticity, properties of gels and pastes, thixotropy, rheopexy, etc., with reference to colloid systems.

With excellent get-up, profuse illustrations and up-to-date references, the book, it is hoped, would be widely bought and extensively read.

M. SANTHAPPA.

Polysaccharide Chemistry. By Roy Lester Whistler and Charles Louis Smart. (Academic Press, Inc., New York), 1953. Pp. viii + 493. Price

In recent years, knowledge of the chemistry of carbohydrates has been vastly augmented. Within the carbohydrate group, there occurs an array of compounds known as polysaccharides possessing highly complicated chemical structure. The present monograph gives a unified account of the entire field of polysaccharide chemistry, thus presenting for the first time an easily accessible volume comprising the available knowledge of all known polysaccharides. Consequently, much hitherto unassembled

material is brought together and each polysaccharide is dealt with in a thorough and critical manner. Since the classification and nomenclature committees have not dealt specifically with the polysaccharide field, the authors have adopted the commonly accepted terms. The book contains references to important original papers in the field of polysaccharides. The discussion and interpretations of data are throughout presented in an authoritative manner and reflect the wide experience which the authors have had in the field. The monograph will prove highly useful both as an advanced text-book to the post-graduate student and as a book of reference to the research worker.

M. SWAMINATHAN.

Interscience Manuals

The Interscience Publishers, Inc., New York and London, are embarking on a new publishing venture, *The Interscience Manuals*.

These handy, low-priced volumes are primarily designed as reliable tools for laboratory procedures. Emphasizing techniques rather than theory, these manuals will furnish in a small compass of about 200 pages, a proper selection of classical and instrumental methods by following the critical recommendations of its carefully chosen authors. Particularly geared for beginners not conversant with the full scope of scientific development, they will provide sound, up-to-date guidance. Here the scientific worker is given a text which will help him to instruct his assistants. Special attention is paid to clear style and lucid presentation. Among the titles in preparation are: Chromatography, Insecticides, Lubricants, Detergents, Ion Exchange, Microfilms and Microcards and Fiber Microscopy.

Introduction to the Theory of Stochastic Processes Depending on a Continuous Parameter. By Henry B. Mann. National Bureau of Standards, Applied Mathematics Series 24. (Order from Government Printing Office, Washington 25, D.C.), Pp. v + 45. Price 30 cents.

Chapter 1 gives the fundamental concepts and some of the principal theorems. In Chapter 2, two processes known from the theory of Brownian motion are discussed. Chapter 3 deals with the statistical estimation of these two processes. Chapters 4 and 5 discuss differential processes. The topic of Chapter 6 is the Fourier analysis of stochastic processes.

This small volume is addressed to the educated mathematical statistician although the

author has made a real effort to develop the theory of stochastic processes with as little resort to abstract measure theory as possible. The user of time-continuous processes in the applied fields who is not interested in the methods of proof may still appreciate having a number of important definitions and results conveniently arranged in one place and with a unified terminology and notation.

BCG Vaccination. (Studies by the WHO Tuberculosis Research Office, Copenhagen). World Health Organization: Monograph Series, No. 12. Pp. 307. Price 15 sh.

The WHO Tuberculosis Research Office, in collaboration with the Danish Statens Seruminstitut and the International Tuberculosis Campaign, undertook an intensive investigation of the basic problems of tuberculosis immunization, with special reference to BCG.

The results of the work done during the first three years of the research programme are assembled in a detailed report which has just appeared as No. 12 in the Monograph Series of the World Health Organization. This monograph is, by its unbiased observations and critical analysis, an important contribution to the understanding of the problems involved in BCG vaccination.

The investigation reported in this monograph consisted of a series of separate studies, each concerned with one or more problems regarding BCG vaccination. The subjects examined include: effects on the vaccine of long-continued storage, heat, and light; changes in the technique of intracutaneous vaccination; variations in the preparation and concentration of the vaccine; mixtures of living and dead bacilli in different proportions; and the variability of vaccines prepared by different producers.

Altogether, more than 40,000 school children in Denmark, Mexico, Egypt and India were given pre-vaccination tuberculin tests, on the basis of which some 23,000 were vaccinated. Post-vaccination examinations were carried out 2-3 months, one year, and two years later and included measurement of reactions to an intracutaneous tuberculin test, measurement of the scar at the site of vaccination and observation of the local complications of the vaccination.

Complete quantitative data for all the tests and examinations, constituting a "source book" for all workers in this field, are given in tabular form as appendices.

As pointed out in the introduction, "This report describes an adventure in international re-

search, planned to meet an international need and carried through with the help of health authorities, doctors, and laymen in many lands."

Annual Report 1952, National Bureau of Standards, U.S.A. (Order from Government Printing Office, Washington 25, D.C.). Pp. 89 + 28 Halftone illustrations. Price 30 cents.

Summarizing scientific and engineering investigations conducted by NBS during the fiscal year 1952, this booklet contains accounts of current activities as well as more detailed descriptions of representative projects.

Major fields of activity include the following: electricity, optics and metrology, heat and power, atomic and radiation physics, chemistry, mechanics, organic and fibrous materials, metallurgy, mineral products, building technology, applied mathematics, electronics, radio propagation, ordnance development, and basic instrumentation.

Books Received

Statistics for the Social Sciences. By T. G. Connolly and W. Sluckin. (Cleaver Hume Press Ltd.), 1953. Pp. vii + 154. Price 16 sh. net.

Chemical Analysis of Industrial Solvents, Vol. VII. By Morris B. Jacob and Leopold Soheflan. (Interscience Publication, New York), 1953. Pp. xxii + 502. Price \$10.00.

Power Cables: Their Design and Installation, Vol. I, 3rd Edition. By C. C. Barnes. (Chapman & Hall Ltd.). Pp. xv + 271. Price 35 sh. net.

Starch and Its Derivatives, Vol. I, 3rd Edition. By J. A. Radley. (Chapman & Hall, Ltd.). Pp. xi + 510. Price 65 sh. net.

Fatigue of Metals. By Cazaud. (Chapman & Hall Ltd.), 1953. Pp. xiv + 334. Price 60 sh. net.

The Annual Report of the Sugar Breeding Institute, Coimbatore. (Published by the Order of the Government of India, Ministry of Food and Agriculture, New Delhi), 1950-51 and 1951-52.

Survey of Biological Progress. Edited by George S. Avery Jr. (Academic Press Inc. Publishers, New York), 1952. Pp. vii + 333. Price \$7.00.

Epidemiology and Control of Endemic Syphilis. By E. I. Grin. (World Health Organization, Monograph Series, Geneva), 1953. Pp. 93. Price \$1.00.

SCIENCE NOTES AND NEWS

Norwegian Technical Aid to India

The Norwegian Technical Aid Programme is being concentrated in two small fishing communities in the Travancore-Cochin State in South-West India. The Norwegian Parliament has already made a grant to finance the programme, and the campaign has been launched to raise another £ 500,000 by voluntary contributions from all over Norway. Norwegian experts are now arriving in India to implement the programme which is aimed at raising the efficiency of the fishing fleet, by mechanising the boats and introducing new techniques, and increasing the value of the catch by the establishment of processing and refrigerating plants. Also, health standards will be raised, and particular importance is attached to providing the inhabitants with a pure water-supply.

International Association of University Professors and Lecturers

More than 120 delegates from 32 different countries attended the Seventh General Meeting of the International Association of University Professors and Lecturers at Amsterdam. Among the items of discussion during the four days of the meeting were such points as "Scientific Research in Industry and at the Universities", "Academic Liberty", "The Status and Salary of the University Tutor", "The Exchange of University Personnel" and "Equality of University Degrees".

Union Catalogue of Medical Periodicals in Indian Libraries

The catalogue is a revised edition of the consolidated catalogue published by the Directorate-General of Health Services, Government of India, as Vols. I-II in 1948-49. It is hoped that this catalogue will go a long way to help the medical research workers of the country to ascertain from what source particular references will be available which may be required in connection with their work. The volumes can be had on loan by medical research workers on an application to the head of the institution concerned under rules and regulations in force at the time.

Rubber Research Institute Publication

The Rubber Research Institute of Malaya have prepared a comprehensive leaflet listing

all their publications of current interest, with revised prices. A copy of *Publications of the RRI* may be obtained free by writing to the Director, Rubber Research Institute of Malaya, P.O. Box 150, Kuala Lumpur, Malaya.

World List of Plant Breeders

The FAO has published a Supplement to the *List of Plant Breeders in Canada and the U.S.A.*, published in 1949. These two lists, together contain the names and addresses of about 2,100 breeders in 49 countries and territories, as well as information on the crops with which they work. A copy of the list may be obtained free of charge by professional plant breeders on application to the Plant Production Branch, FAO, Rome, Italy, and the request should be accompanied by the name of the plant breeder, official address, crops with which breeding work is in progress and line of research.

Belgian Chemical Directory

The Fédération des Industries Chimiques de Belgique has published a 1953 edition of its Directory.

This work, which gives interesting information about Belgian chemical industry, is divided into the following sections:

Organization of the Federation; List of the Members of the Federation, with details of addresses; List of the products made and sold by the Members; List of the Laboratories affiliated; List of the Sales Organizations; Alphabetic Index, in English, Dutch, Spanish and German; and List of Trade Marks.

The volume (492 pages) is bound in brown cloth and is sold at Belgian Frs. 150, plus B. Frs. 30 for postage. The address of the Federation is: rue Joseph II, 32 in Brussels.

De-Salting Brackish Water

Under the auspices of the O.E.E.C., a working party was set up last year to study the de-salting of brackish water. De-salting is a worldwide problem and concerns many countries where water supplies are short or are likely to become so. They include the Netherlands, South Africa, the West Indies and Pakistan.

The group of experts appointed by the working party is now drawing up its report of the four processes which were considered to merit

further investigation, viz., ion-exchange, separation by freezing, electrolysis and vapour compression distillation. Waters of 1,000, 5,000 and 20,000 parts per million chloride content have been considered. After the report has been studied, the working party should be able to recommend one or more processes for co-operative development to countries of the O.E.E.C., including the United Kingdom. Those interested in the progress of the work on this subject should apply to D.S.I.R., Charles House, 5-11, Regent Street, London, S.W. 1.

8th International Congress of Botany

The Congress will be held in Paris from the 2nd to the 14th of July 1954. The Congress will include, besides the plenary sessions and the sessions on various subjects, chiefly sessions devoted to limited subjects of actual interest discussed in the form of symposia. All correspondence should be addressed to: Secretariat-General, du 8 Congress International de Botanique, 292, Rue Saint-Martin, Paris 3, France.

Centenary of Organotin Compounds

The first organo compound of tin was synthesised in 1852. For the past five or ten years, however, interest in these compounds has rapidly grown because some of them are outstandingly good stabilisers of polyvinyl plastics.

The Royal Institute of Chemistry

At the Annual General Meeting of the North India Section of the Royal Institute of Chemistry held in March 1953, the following office-bearers were elected for the year 1953-54. *Chairman*: Prof. T. R. Seshadri; *Hony. Secretary and Treasurer*: Dr. G. S. Saharia; *Hony. Auditor*: Mr. B. N. Sastri.

Award of Research Degree

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri. J. M. Athavale for his thesis entitled, "Synthesis in Benzopyrone Series".

Raptakos Medical Research Fellowships

The Raptakos Medical Research Board will consider applications for the award of Fellowships for research work on medical and allied subjects in recognized institutions situated in

the Union of India. The awards normally consist of Rs. 3,000 per year for a Fellowship and Rs. 750 per year towards special equipment or chemicals.

Each application should be accompanied by six copies of a brief statement of the research project and the comments of the guide regarding the suitability of the project and the facilities existing at the Institution. Fellows should have an M.B.B.S. or M.Sc. Degree or its equivalent or not less than two years' experience in research work after B.Sc. Applications for Grants for the year commencing 1st January 1954, should reach the Secretary, - Raptakos Medical Research Board, 253, Dr. Annie Besant Road, Worli, Bombay 18, before 1st September 1953.

Award of Prizes, University of Madras

The Maharaja of Travancore-Cochin Prizes for 1953-54.—Two prizes, one in each of the following groups of subjects, will be awarded by the Syndicate for the best essay or thesis written by any graduate of the Madras University on a topic dealing with one of the subjects: (1) Botany, Zoology and Physiology; (2) Anthropology and Archaeology. Competitors should submit their theses so as to reach the Registrar not later than the 1st March 1954.

Control of Infections of Elderly Diabetics by Terramycin

A total of 70 diabetic patients were treated with terramycin for varied infections by Dr. Joan B. Walker, Head of the Diabetic Department of the Leicester Royal Infirmary in England. Excellent to good results were obtained in 46 out of 50 cases of infections of the feet, the most common type of diabetic infection, resulting from reduced blood circulation in that area. It was noted that, swelling and pain subsided very rapidly, with conspicuous improvement in 48 hours. Of these patients, 44 were over 60 years of age, and all but one over 50.

Because of its wide range of activity, its lack of unpleasant side-effects and its ease of administration, terramycin appears to be an efficacious and economic drug for control of crippling diabetic infections. A complete report of the studies appears in a recent issue of *The Lancet*.

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THE RAJPUTANA DESERT*

THE RAJPUTANA DESERT is located in the Rajasthan Province in the north-western part of India. It has an area of about 1,30,000 sq. miles with a total population of 15.3 millions.

For practical purposes Rajasthan may be divided into two major divisions: north-west of the Aravalli Hills, an arid and semi-arid area with average rainfall of 4" or less in the west; gradually increasing to the east and south-east to about 14" at Jodhpur, and still higher in the Aravalli Hills. Nearly 80-87 per cent. of the annual rainfall comes during the monsoon months of June-September. These are also months of high relative humidity. There is also widely varying rainfall from year to year and severe droughts every few years. For example, at Jaisalmer rainfall varied from none whatsoever in one year to over 22" in another with an average of only 7". At Bikaner

it varied from 1.1" to over 30" and less than 12" average. Temperatures are moderate in winter and reach 120° F. or more in May and June, the two hottest months. "There is a constant breeze from the south-west to the north-east during the greater part of the year from February to October with a velocity of 8-10 miles per hour. The velocity increases during May to 20 miles per hour.....The winds have a desiccating effect." (p. 226.) Mean monthly evaporation varies from 6-10" for such months as November-February to 20" or more during May and June, the hottest months. Soils are mostly sandy but become more clayey as one approaches the Aravalli Hills.

For a desert area, the population is rather high. Around Jaisalmer there are 4 persons per square mile. Around Bikaner there are 28 per square mile. These are undoubtedly largely concentrated in towns and villages.

South-east of the Aravalli Hills, the second major division, the area is not truly a desert. Annual rainfall is generally over 25", there are some forest areas and much of the land is suitable for cultivation.

* Critical Review of the Proceedings of the Symposium on the Rajputana Desert, held in New Delhi, during March 1952, published as *Bull. National Inst. Sci., India*, 1952, No. 1, pp. 302.

IS THE DESERT EXPANDING ?

There is some difference of opinion as to whether the desert is actually encroaching on adjacent areas. Some believe that it is extending north-eastwards at the rate of $\frac{1}{2}$ mile a year. M. S. Krishnan in his *Geological History of Rajasthan and Its Relations to Present-Day Conditions* states (p. 30): "Aridity gradually developed during the last 5,000 years, and with it, inland drainage and salinity of the waters." H. D. Sankhalia says (p. 48): "It is not unlikely that witnessing the increasing aridity, the population trend about the 3rd century B.C. or a little before was towards the habitation of the more fertile eastern zone."

S. K. Pramanik believes there is no change in weather over the last 70 or 80 years. On the other hand, S. K. Banerji, studying actual weather data at individual stations, finds a general downward trend in rainfall from about 1860-1920 and a continuing downward trend to 1940 in the area north-west of the Aravalli Hills, except at Jodhpur. In the area south-east of the Aravalli Hills, there was a downward trend to 1920, but not since.

M. B. Pithawalla (p. 147) says, "the most important cause is human interference, such as cutting down of forests in the upper reaches of the rivers, diversion of flood waters for irrigation, intensive grazing and destruction of dams and barriers". K. V. Krishnamurthy states that "the extension of desert conditions has not been due to the deterioration of meteorological factors but due to other causes". He quotes R. M. Gorrie (p. 133), "I think that the land adjoining the desert is not being engulfed by sand though it is slowly deteriorating as a result of increasing desiccation in south and south-western Punjab. It is, no doubt, difficult to distinguish between the land deteriorating as a result of desiccation and the land being engulfed by sand as a result of the advance of the desert".

VEGETATION

There are shrubby trees in the Aravalli Hills. Generally, over the rest of the semi-arid area there is shrubby vegetation with sometimes an undergrowth of annuals and perennials. In the desert proper, there appears to be very little vegetation except some annuals during the rainy period. According to Shanti Swarup (pp. 223-32), most of the plants are annuals which come during the rainy season although there are some perennial shrubs and salt-tolerant plants, such as *Salsola foetida* and *Altriplex cressifolia* in the salty areas and *Tamarix* along water-courses. Hem Singh

Pruthi (p. 242) states that annuals appear shortly after the commencement of the rainy season and in years of good rainfall, normally cover practically the whole of available space. Their life is short, however, and they wither when the soil becomes dry as a result of the withdrawal of monsoon.

N. V. Kanithkar states that from available information it may be possible to grow crops with varying success when the rainfall is above 15". Below 15", crop growing is uncertain and below 10", it is likely to be a year of famine. However, Pruthi mentions cultivation of several species between the dunes which would appear to be in areas below 15" of rainfall.

USE OF NATIVE VEGETATION

All statements regarding this indicate that it is excessive. There are such references as "wholesale destruction of forests", "intensive grazing" and "besides the damaging effects of livestock on vegetation, their owners cut down all foliage and/or collect foliage for use as fodder in the off season".

In addition to domestic livestock which undoubtedly migrate, there are also some wildlife and the desert locust. According to Pruthi, the desert locust "destroys the annuals and perennials, devouring both leaves and bark leaving only woody portions behind".

Nevertheless, the livestock industry which is the main industry of the area, apparently is of importance to India. J. Banerji in discussing this (p. 279) emphasizes the manufacture of wool, woollen fabrics and blankets. He says the total sheep population is estimated to be 4 million with most of the wool exported. B. W. Ganguli (p. 275) says the Jumnapari goat is the pride of India, but it is reared under conditions which are disastrous from the long-range point of view.

RECOMMENDATIONS

Ganguli emphasizes the need for laws comparable to a number of Middle-Eastern laws aimed at controlling grazing. M. D. Chaturvedi recommends a Desert Research Institute Station at Jodhpur and a programme of afforestation. J. Banerji in discussing possible control states (p. 280) that "the 320 sq. miles of Khalsa area under the Forest Department are covered with open xerophytic scrubs and small trees, chiefly *Anogeissus pendula* (Dhok.), *Acacia catechu*, *Acacia leucophloea*, *Cassia auriculata*, *Salvadora oleoides*, and *Prosopis spicigera*. Effective and continuous protection of these forests located on the slopes of the Aravallis, and their

management under a properly sanctioned working plan with control of grazing are essential, and will be possible through the local technically trained Forest Department". He discusses artificial regeneration procedures necessary for establishment and mentions that 163 trees, shrubs and herbs, 50 Indian grasses and 37 foreign grasses have been recommended by the Forest Research Institute at Dehra Dun.

F. R. Bharucha emphasizes the need for plant ecological research and especially the problem of succession of vegetation of the shifting dunes will have to be studied thoroughly.

It is somewhat surprising to see so little reference to the possibility of bettering the situation through management of the native forage that is now growing in the desert or to the need for range research. Controlled grazing would be but the first step.

U.S.A. SITUATION AND EXPERIENCE

It appears that the situation in the Rajputana is much like that which prevailed in the arid portions of the U.S.A., several years ago. At the end of World War I, for example, there were excessive numbers of cattle, sheep and goats on range lands of the U.S., partly as a result of the urge to expand herds during the war and accompanying high prices. Such excessive grazing over 30 or 40 years had brought about serious deterioration of the range resource, which, of course, was accentuated by droughts. I have actually seen in southern New Mexico, for example, the mesquite sand hill type (a very low producing type) extend $\frac{1}{2}$ mile or more into what was valuable perennial grassland within 10 years. Climatic conditions there are nearly like those of the Rajputana Desert, less than 9" of rainfall annually on the average 55 per cent. or more coming in July, August and September when perennial grasses grow, frequent drought years and high evaporation. Other range areas in that same general locality were changed during three drought years (1916-18), with heavy stocking during the war, from valuable perennial grasslands having, it is true, a rather scant stand of grass, to land supporting only low value weeds and worthless half shrubs.

Accompanying the deterioration of vegetation there were many adverse results in excessive blowing of sand, loss of organic material in the soil and serious water erosion, especially of clay soils. As a result of less absorption of rainfall by soils, there was greater loss of water through surface run-off. This left less moisture available for plant growth. On clay subsoils, more moisture is required for production of the same

quantity of dry vegetable matter by the vegetation. This has accentuated the adverse growth conditions and has further reduced production of forage. Thinner strands of vegetation have increased surface temperatures and the increased evaporation from the soil has led to additional loss of water without benefit to vegetation. Thus, the local and microclimate have changed adversely as vegetation deteriorated in the semi-arid and desert areas of U.S.A. having somewhat comparable annual rainfall. All of this has tended to result in a change to more drought-resistant vegetation, usually of less usability for livestock grazing.

With increased erosion, main drainage ways become clogged with soil washed from slopes. During rapid run-off following heavy storms, this greater quantity of silt gives greatly increased cutting power and erosion of sides of gullies. All of this means greater movement of sediments in stream courses and increased deposition in irrigation and other reservoirs.

Through research and experience, it has been found that such arid and semi-arid lands can be improved in native forage production through management; but the process is usually very slow, much slower than the rate of deterioration. This undoubtedly is due to less moisture being available for vegetation due to excessive run-off, more moisture required for the same vegetative production, lower fertility of the soils and other similar factors resulting from range deterioration which make natural growth more difficult, and all of these factors are accentuated during severe drought years. In order to bring about natural recovery, the vegetation must not be over-utilised and must be given a chance periodically to make normal growth. Since normal growth cannot be permitted over the entire range area, the "deferred and rotation system of grazing" has been developed to give the several portions of the range area a chance in turn to make full growth before being grazed at a suitable degree and under other sound phases of management.

There are many examples of recovery through application of improved range management in the U.S.A. The palatable forage, especially grass, has more than doubled in 4 or 5 years on experimental areas of sandy, desert lands of the Jornada Experimental Range of southern New Mexico grazed by cattle throughout the year under sound practices. Also winter sheep ranges on the desert experimental range of western Utah with about 7" of rainfall annually on the average, properly managed, produced 3 times as much forage as in their deteriorated condition within a ten-year period.

A deteriorated goat range in New Mexico having an average of about 12" of rainfall annually doubled its grazing capacity through effective seasonal degree of grazing, during a three-year drought period (1916-18) when rainfall was much below average and while many other range areas in the same locality were rapidly deteriorating under unwise use.

Through suitable management, including moderate grazing of perennial grasses each year, appropriate shifts of grazing and other suitable practices, the recovering vegetation can be grazed with increased production of livestock. On the Jornada Experimental Range, for

example, production of beef from each cow carried has practically doubled during the past 20 years. The extreme variation in production between good and drought years has been narrowed. Also both sheep and goat production is greater under sound range management.

The situation and experience on range lands in the U.S. might have value in considering the situation in the Rajputana, although results in the U.S.A. would undoubtedly not have direct application.

Forest Division,

W. R. CHAPLINE.

Food & Agric. Orgn. of the U.N.,
Rome.

WEALTH OF INDIA—RAW MATERIALS, VOL. III*

THE first volume of this encyclopædic work on the natural resources and industrial products of India appeared in December, 1948; the second was published towards the end of 1950.

The first two volumes were warmly received by the Press and the scientific circles, both in India and abroad. Handsome tributes were paid to the manner in which the work has been planned and executed, and to the format and neat printing of the volumes.

The third volume, just released for distribution contains articles under letters D & E and deals *inter alia* with about 600 species of economic plants, 3 minerals and 4 animal products.

In the case of botanical subjects, the scientific name of the genus forms the title of each article, and is followed by a brief account of the genus. The important economic species are

described in the alphabetical order of their scientific names. After the title, the common English name, if any, and the standard references are given. Names in Indian languages are from regional floras and published lists of Indian names. No attempt is made to give a botanical description of either the genus or the species. The parts of economic importance, however, are described adequately. Where the species are of minor importance, a short generic note is considered sufficient. The distribution given is according to standard Indian floras. Purely ornamental or horticultural plants are not included.

For minerals and animal products, their common names have been found more convenient. Articles on minerals have been scrutinised by the Geological Survey of India. Occurrences have been listed in great detail, owing to the absence of precise information regarding reserves.

This volume also includes a valuable index to the regional, trade and common English and Indian names, found in the first three volumes.

* Published by the Publications Division, Council of Scientific and Industrial Research, India, 1952. Pp. xx + 236 + xxix. Price Rs. 18.

LADY TATA SCHOLARSHIPS AND GRANTS

THE Trustees of the Lady Tata Memorial Trust have announced the awards of Scholarships and Grants for the year 1953-54.

The International Awards of varying amounts (totalling £ 5,370) for research in diseases of the blood with special reference to Leucæmias are made to Doctors A. R. Gopal Ayengar (India), J. Kieler (Denmark), J. B. G. Dausset (France), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), C. Merskey (South Africa), Charles Oberling (France), R. Rask-Nielsen (Denmark), R. Robineaux (France), C. C. Ungley (England), J. Nordmann (France),

N. A. Stenderup and F. Kissmeyer-Nielsen (on a joint research project) (Denmark).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. P. Venkateswarlu (Trivandrum), Rajaram Vasudeo Bhagwat (Bombay), P. R. J. Gangadharam (Bangalore), N. V. Bringi (Bombay), Dr. Purindra Nath Sen Gupta (Patna), Dr. (Mrs.) M. Aikat (Gwalior) and Miss K. S. Laul (Bombay).

DESIGN FOR A BRAIN

THE problem of how the brain functions in living organisms to produce the kind of behaviour designated as 'intelligent', 'purposeful' or 'adaptive' is one to which much attention has not been directed so far. While it is not disputed that the brain, whether in man or the lower organisms, resembles a machine in many ways, many workers believe that a mechanical model, however intricate, can never explain satisfactorily the capacity of the brain 'to learn by experience'.

In this connection, the volume *Design for a Brain** by Dr. Ross Ashby will be read with wide interest; for Dr. Ashby proceeds to show how a mechanical model can, in fact, be constructed having the capacity to adapt itself to the environment. In other words, the model reacts to external stimuli in such a fashion that its behaviour improves with each new experience. Naturally, only simple examples can be given at present exhibiting this capacity; even so, it is interesting to study in broad terms what the properties of such a system should be, subject to the known laws of mechanics, if it is to behave adaptively.

Dr. Ashby finds the solution in the existence of 'step functions' among the various parameters defining the behaviour of a system. While a large majority of the parameters are continuously variable, these step functions can take only specific values. For a particular value of a step function (S, say), the behaviour of the system with respect to the rest of the variables will appear to be independent of S, but if S changes by a discrete jump to a new value, the whole field of the other variables will be entirely altered. A physicist is strongly reminded in this connection of some of the concepts of quantum mechanics, such as eigen-values and stationary states.

Suppose it is arranged that S undergoes a transition only if the system is unstable with respect to the other variables, say, if one of the variables exceeds a given value. Then, for the new value of S, the system may be stable, the other parameters remaining unchanged. If not, S undergoes further transitions until a suitable value is attained for which the system is stable, and thereafter a small disturbance does not make it unstable and no further transitions take place. It is obvious that such a system is able to adapt itself without any further external influence, for the step function is

automatically altered as a result of the first few encounters until the system reaches a stable condition. In other words, if the facility of altering step functions every time an instability is encountered is included in the design of the machine, it is able 'to learn by experience', and always attains a stable state, irrespective of what state is started from. Such a system is called an "ultra-stable system". Here again, Dr. Ashby makes a statement which is interesting: the speediest way of reaching the stable state is not through systematic changes in step functions, but through a *random* choice of the allowed values of the step function.

Dr. Ashby has in fact constructed an apparatus consisting of four magnets interacting with one another, which he calls a 'homeostat', illustrating many of the above principles. If arbitrarily disturbed, it always returns within three or four steps to a stable state, in which it continues to remain until it is disturbed again.

The essential difference between the principles of ordinary automatic control and the homeostat is best shown by the following example. The automatic pilot is a device which, amongst other actions, keeps the aeroplane horizontal. It is, therefore, connected to the ailerons in such a way that when the plane rolls to the right, it exercises a corrective action on them and rolls the plane to the left. The homeostat, if joined this way, may also do the same. Now connect the ailerons in the reverse way and compare the present behaviour of the two systems. Whereas the automatic pilot will tend to increase the roll after a small disturbance and persist in its action to the very end, the homeostat will do so only so long as the increasing deviations made the step functions start changing. Afterwards, it would take on suitable new values and start stabilising. It would then be ordinarily self-correcting with respect to disturbances.

Here are entirely new concepts, which have immense possibilities in physics and engineering, apart from their ability to explain the phenomenon of adaptation in living beings. As will be clear from the foregoing, the concepts are essentially mathematical, but Dr. Ashby has explained these in his book with remarkable clarity and elegance. In the first 200 pages, he has stated his thesis in plain words, aided by a number of diagrams and tables, and then reformulated them in precise mathematical form in an Appendix of 60 pages. However, the first part never lacks in precision or rigour, which

* *Design for a Brain*, by W. Ross Ashby. (Chapman and Hall), 1952. Pp. ix + 260. Price 36 s.

forcibly brings out the fact that mathematics is only a tool for simplifying the manipulation of ideas and that it leads to no new result unattainable by logical thinking.

Dr. Ashby has succeeded in showing that mechanical systems may be made to modify their behaviour according to the conditions met with. But in extending this idea to living beings, a few points need to be carefully considered. While it is true that an ultra-stable system is "goal-seeking", the goal has to be known even before the system is built up. For a mechanical system, it may be defined as that state in which the system is "stable". However, with living beings, the goal itself may vary according to circumstances. In such a case, it is quite possible that other types of special properties will have to be invoked for various parts of the system.

For instance, no method has been suggested in the book whereby an ultra-stable system can "learn" by experience, that is to say, how the adaptation to a particular environment from a general state can be made more rapid during a second or succeeding encounters. Obviously, a mechanism must be devised whereby the random choice of step function values is changed to *deliberate* choice if the same environment is met with once again. These are rather recondite points, which need be considered only in future developments of the theory. There is no doubt that the present book by Dr. Ashby is an outstanding contribution to the mechanistic explanation of the behaviour of living beings.

G. N. RAMACHANDRAN.

NRX, THE CANADIAN HEAVY-WATER PILE

THE NRX reactor at the Canadian Atomic Research Station at Chalk River has made possible a whole range of investigations in atomic energy and nuclear physics, not practicable elsewhere.

In reactors using natural uranium, the fast neutrons produced by the fission of the uranium 235 nucleus have to be slowed down to thermal energies to increase their chances of causing the fission of other uranium 235 nuclei, and the slowing-down process is achieved by the use of a 'moderating' material. In all existing reactors, the moderator is either graphite or heavy water. The American and British projects, with their emphasis on military uses, have concentrated on graphite-moderated reactors, which are most productive of plutonium. Canada, on the other hand, has been concerned with developing heavy-water reactors. The first, a low-power reactor known as ZEEP, gave the experience necessary for the construction of the second heavy water reactor, the NRX pile. The great advantage of using heavy water as

the moderator instead of graphite is that it makes possible a smaller and more compact pile, and this means a pile with a higher neutron flux for a given power. The NRX pile, which was designed with power rating 10 megawatts, has a maximum neutron flux of 6×10^{13} neutrons/sq. cm./second, which is 10-20 times the flux in a graphite reactor of comparable size.

This very high neutron flux has made possible the commercial production of radio-active material in unrivalled concentrations, such as cobalt 60 which is produced by neutron irradiation of ordinary cobalt, and which is used as a substitute for radium in therapy and radiography because of its emission of penetrating gamma rays. It takes 18 months' irradiation in the high flux of the NRX pile to produce radio-cobalt samples with a specific activity of 35 curies per gm. Pieces of irradiated cobalt, which have an effective strength of 1,000 curies a piece, have been made for Canadian hospitals and used in cancer therapy.

VPI CRYSTALS FOR PREVENTING RUST

DICYCLOHEXYL ammonium nitrite, known commercially as the Vapour Phase Inhibitor, or VPI, is being used to-day to protect such a variety of products as small machine parts, aircraft engines, wire, hand tools—even tiny watch parts and huge diesel engine crankshafts. It not only affords greater protection than previous methods of rust prevention, such as coatings of grease, but it also reduces cost and is

more convenient to use. When a small steel part, such as a gear, is wrapped in a sheet of VPI coated paper, coated side next to the gear, the VPI slowly vaporizes and diffuses all around the part. Oxygen that was present when the gear was wrapped is thus effectively neutralised.

Its rust-prevention qualities were first discovered by the Shell Oil Company, U.S.A.

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THE MINIMUM VELOCITY OF PARTICLES IN DOPPLER DISPLACEMENT OF HYDROGEN

THE light of canal rays of hydrogen which shows Doppler effect, consists mostly of light due to H_{α} , H_{β} , etc., of the Balmer series from neutral hydrogen atoms. The effect for H_{α} can be represented diagrammatically (Fig. 1) as a strip AB of varying intensity separated from the sharp line at O, which is H_{α} itself without change of wavelength (i.e., an undisplaced H_{α} line). The undisplaced line is given out by atoms of hydrogen gas in the space in which the canal rays are moving (since these particles are having velocities negligible compared to the very high speeds of the canal ray particles). Lower edge A represents the least displaced end of the Doppler strip and the wavelength displacement OA may, therefore, be represented as $d\lambda_1$ which gives the least velocity of particles of hydrogen represented in the canal-ray-beam. The maximum displacement $d\lambda_{\max}$ is represented by B. Its behaviour has

been extensively studied.¹ The present communication is concerned with the behaviour of $d\lambda_1$ of A with variation of the potential applied to the discharge tube producing the canal ray.

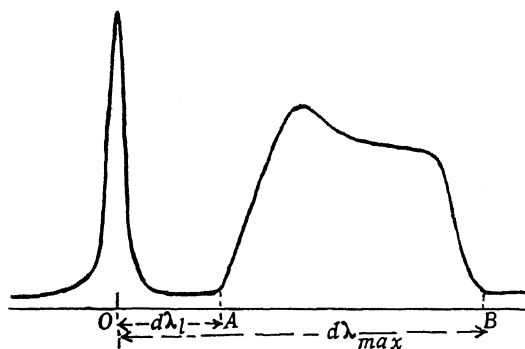


FIG. 1. Sketch of Doppler Displacement to show Undisplaced Balmer Line H_{α} at 'O' and Doppler strip 'AB' with Displaced Maximum at 'B' ($d\lambda_{\max}$) and Minimum at 'A' ($d\lambda_1$).

Steinheil three-prism glass spectrograph of high light-gathering power, $f/3$, and effective

base of 30 cm. was used. With a tele-objective attachment $f = 250$ cm. to the camera side, the dispersion was 11.92 \AA/mm . In order to avoid complications from the background molecular lines and the continuum, we have made observation on H_α . Purity of gas in the discharge tube has been maintained by Wien's method of capillary streaming and continuous pumping.

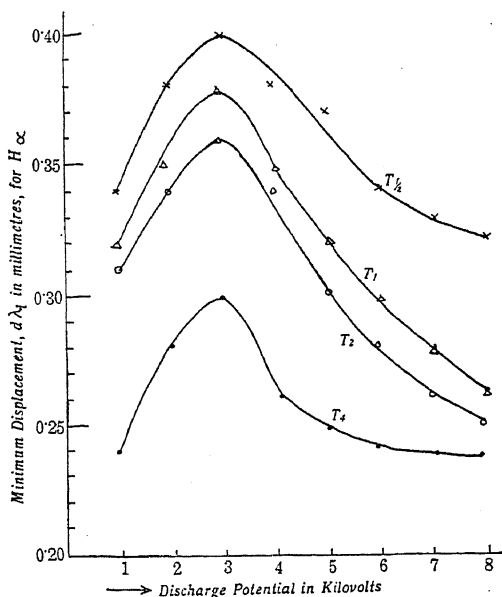


FIG. 2. Minimum Doppler Displacement for H_α .

Results are shown in Fig. 2. On one and the same plate, keeping time of exposure constant (say, 4 hours), photographs were taken at different discharge potentials from 1 to 8 kilovolts, varying by steps of 1 kilovolt. Similar plates were prepared with exposure times, 2, 1 and $\frac{1}{2}$ hours also. All the four curves (T_4 , T_2 , T_1 , $T_{1/2}$ respectively) show a uniform behaviour in their values for $d\lambda$, having first a rise for potentials from 1 to 3 kilovolts, reaching a maximum at 3 kilovolts and then falling gradually with increase of voltage, up to the highest voltage used. The pressure of the gas corresponding to 3 kilovolts is 0.09 mm. Hg.

It was shown by B. Dasannacharya and G. K. Das,² as conclusion No. 9 of their paper that a strip due to neutral atoms formed as a result of dissociation from a heavy molecule of hydrogen of mass 4 exists, only in the voltage region, 1 to 3 kilovolts. The disappearance of this strip at 3 kilovolts can be regarded as the cause for a fall in the intensity of the lower limit of the Doppler strip, observed in the

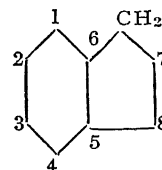
present result. Further details will be published elsewhere.

Dept. of Physics, M. SAKUNTALA.
Benares Hindu University, B. DASANNACHARYA.
March 17, 1953.

1. Dasannacharya, B. and Das, G. K., *Nature*, 1944, 154, 21; — and Dakshinamurti, C., *Ibid.*, 1944, 154, 22; —, *Curr. Sci. Canal Rays Special Number*, 1937. 2. — and Das, C. K., *Phil. Mag.*, 1948, 39, 966.

ELECTRONIC ENERGY LEVELS OF INDENE

THE electronic energy levels of the Indene molecule have been calculated by the method of antisymmetrised molecular orbitals. The structure of Indene is:



The assumptions made in these calculations are:

- (i) Indene has eight π electrons which are responsible for spectroscopic levels;
- (ii) The molecular orbitals can be written down as follows:

$$\phi_l = \frac{1}{\sqrt{8\sigma_1}} \sum_{k=1}^8 e^{\frac{2\pi i l k}{8}} K(v)$$

($l=0, \pm 1, \pm 2, \pm 3, 4$)

σ_1 being a normalisation factor, $K(v)$ being the $2p\pi$ atomic orbital of the k th atom. The numbering of the atoms is indicated above.

| e.v. | Level |
|--------|---------|
| 11.82 | 1A_1 |
| 10.628 | 3A_1 |
| 10.615 | 1A_1 |
| 8.39 | 1A_1 |
| 3.89 | 3A_1 |
| 0.36 | 3A_1 |
| 0 | 1A_1 |

3187 Å
(2952 Å)

- (iii) The interaction between electrons, partially on non-neighbouring atoms as also that between electrons 1, 2, 3, 4, on the one hand and 7, 8 on the other, is negligible. Effect of the hydrogen atoms and the spin orbit interaction is neglected;

(iv) The C = C distance is taken as 1.39 A.U.

Reckoning from the ground level, the energy levels in e.v. are shown in the adjoining diagram (not to scale). The observed bands at 2952 A.U. are assigned to the transition from 3A_1 (3.89) to the ground state 1A_1 .

Full details will be published elsewhere.

Physics Department, S. RAMAMURTY.
Andhra University, Waltair,
May 15, 1953.

OCCURRENCE OF A HOLOSPORELLA IN THE NINIYUR GROUP (DANIAN) OF THE TRICHINOPOLY CRETACEOUS, S. INDIA

PROF. L. RAMA RAO collected some time back certain specimens of cherts from near Otakoil similar to those of the adjacent Niniyur group, and after a preliminary examination, pointed out that these specimens contained an extraordinarily rich abundance and variety of exceedingly well preserved Dasycladaceæ, including several new forms not described in the 1936 memoir.¹

In the course of a detailed study by the author of these Dasycladaceæ, now under progress, the occurrence of Holosporella, similar to Holosporella siamensis of Julius Pia, has been noticed. Pia² first erected this new genus in 1930 to designate a primitive "endospore" Dasycladaceæ found in certain upper Triassic

rocks from the Burmo-Siamese frontier. In sections of the Niniyur cherts now under study, a similar Holosporella occurs,—both longitudinal and cross-sections being noticed. These views are reproduced in Figs. 1 and 2.



FIG. 2. ($\times 50$)

In this connection, it may be pointed out that S. R. Narayana Rao and K. Sripada Rao have also recorded the occurrence of Holosporella cf. H. siamensis in the inter-trappean limestones (early Eocene) of the Rajahmundry area, and a description of this form was published in 1936.³ The following table of comparative measurements of these 3 Holosporellas shows their general similarity:

| Dimensions (in mm.) of | Holosporella cf. H. siamensis S. R. N. Rao and K. S. Rao, 1936 from Rajahmundry | Holosporella siamensis Pia, 1930 from Siam | Holosporella, from Niniyur |
|---------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------|
| Outer diameter of cylinder | about 0.51 | about 0.4 | about 0.30 |
| Diameter of central perforation | „ 0.21 | „ 0.15 | „ 0.14 |
| Diameter of globules | „ 0.12 to 0.15 | „ 0.21 to 0.13 | „ 0.10 to 0.14 |
| Thickness of membrane | about 0.01 | „ 0.01 | about 0.01 |
| Number of globules seen in cross-section | „ | „ 10 | „ 8 |
| Stratigraphical horizon | Early Eocene | Upper Triassic | Danian |



FIG. 1. ($\times 50$)

Referring to the Rajahmundry occurrence, Pia said that "the existence of an endospore Dasycladaceæ in so high a geological horizon is quite unexpected a fact" and is "obviously

most perplexing". The present find of a similar *Holosporella* in the Danian Niniyur beds, is another example of such an unexpected occurrence.

The detailed studies of this and other *Dasycladaceæ* from Otakoil will be published elsewhere.

The author is thankful to Prof. L. Rama Rao for his valuable guidance, to Sri. M. G. C. Naidu for his helpful encouragement, and to Sri. M. M. Veerabadriah for assistance in photomicrographic work.

Dept. of Geology, S. SAMBE GOWDA.
Central College, Bangalore,
April 8, 1953.

1. Rama Rao, L. and Julius Pia, *Mem. Geo. Sur. Ind. Pal. Indica*, 1936, **21**, No. 4. 2. Julius Pia, *Rec. Geo. Sur. Ind.*, 1930, **63**, Pt. 1. 3. Narayana Rao, S. R. and Sripada Rao, K., *ibid.*, 1936, **71**, Pt. 4.

PYROPHOSPHATE COMPLEXES OF TIN AND ZINC

A NUMBER of metals form complexes with alkali pyrophosphates, but very little is known on the nature of these complexes. Rogers and Reynolds¹ have reported that zinc complexes with P_2O_7 : metal ratio of 2:1 as well as 1:1 exist in solution, and Haldar² mentions only the 2:1 ratio. No information appears to be available on tin.

In this investigation, complex formation with tin and zinc has been studied at room temperature by potentiometric and conductometric titrations of 0.100 M sodium pyrophosphate with 0.148 M zinc sulphate or 0.175 M stannous chloride (dissolved in the minimum quantity of HCl), and *vice versa*. For conductometric titrations, the solutions have been diluted 25 to 50 times. Antimony as well as glass electrodes have been used for the potentiometric method and the Kohlrausch bridge for the conductometric. There are two changes in the curves (potential-titrant; conductivity-titrant) corresponding to complete precipitation of metal pyrophosphate (stannous or zinc) and formation of the complex. The ratio of P_2O_7 : metal corresponding to these changes, is 1:2 for tin and zinc, i.e., $Sn_2P_2O_7$ and $Zn_2P_2O_7$ (precipitate), and 1:1 for tin and 2:1 for zinc respectively, i.e., $[Sn(P_2O_7)]^{-2}$ and $[Zn(P_2O_7)_2]^{-6}$ (complex).

The metal ion concentration of tin and zinc in the pyrophosphate complex solutions has been determined by measuring the static potential of these metals in the solutions against a

saturated calomel electrode. The range of composition of the solutions is: stannous pyrophosphate 20-60 g./l., sodium pyrophosphate 120-360 g./l., zinc pyrophosphate 40-60 g./l., sodium pyrophosphate 220-330 g./l. The tin ion concentration is of the order of 10^{-14} g.ion/l. (60° C.) and zinc ion concentration 10^{-7} g.ion/l. (42° C.). The instability constant K of these complexes has been calculated from the metal ion concentration and found to be of the order of 10^{-14} for tin and 10^{-7} for zinc. Haldar² has reported a value of the same order for K in the case of zinc.

The electroplating of tin and zinc from the complex pyrophosphate solutions has already been briefly reported by Vaid and Rama Char.^{3,4}

Our thanks are due to Prof. K. R. Krishnaswami for his keen interest in the investigation. Electro-Chemistry Lab., J. VAID.
Dept. of General Chemistry, T. L. RAMA CHAR.
Indian Institute of Science,
Bangalore-3,
April 10, 1953.

1. Rogers and Reynolds, *J. Amer. Chem. Soc.*, 1949, **71**, 2081. 2. Haldar, *Curr. Sci.*, 1950, **19**, 283. 3. Vaid and Rama Char, *Ibid.*, 1952, **21**, 310. 4. —, *J. Sci. and Ind. Research, India*, 1952, **11B**, 503.

ELECTRODEPOSITION OF COPPER-TIN ALLOYS FROM THE PYROPHOSPHATE BATH

COPPER-TIN alloy deposits are used in decorative and protective finishing of metals. Electrodeposited speculum containing 40-45% tin is silvery-white, hard and resistant to corrosion and tarnishing. The stannate-cyanide bath is employed for the commercial electroplating of copper-tin alloys,^{1,2,3} and solutions of the oxalate type have also been studied.⁴ The only reference to the use of the pyrophosphate-bath is to the old work cited by Bennett⁵ which, however, gives no indication of the bath composition or the plating conditions.

Vaid and Rama Char⁶ have shown that the complex pyrophosphate-bath is suitable for tin plating. Copper has also been successfully electrodeposited from the complex copper pyrophosphate-bath in this laboratory⁷ as well as elsewhere.^{8,9} As both the metals form complexes with pyrophosphate, this bath appears promising for co-deposition. Cathode potential measurements of copper and tin in pyrophosphate solutions confirmed this possibility.

The plating bath contains copper pyrophosphate, stannous pyrophosphate, sodium pyrophosphate and disodium hydrogen phosphate. The latter helps in preventing the tendency of the bath to precipitate after sometime (about 3 hours). Table I shows the effect of variation of the c.d. and copper content of the electrolyte on alloy deposit composition.

TABLE I

Bath Composition : (i) Stannous pyrophosphate 60 g./l., Sodium pyrophosphate 360 g./l. (ii) Copper pyrophosphate corresponding to copper content given below, Sodium pyrophosphate = 4 times copper pyrophosphate. (iii) Disodium hydrogen phosphate 20 g./l. Temperature, 60° C., Still, Cathode and Anode—platinum, pH : 8.6-8.7

| Copper content of solution g./l. | Composition of alloy deposit | c.d. amp./dm. ² | | | | |
|----------------------------------|------------------------------|----------------------------|------|------|------|------|
| | | 0.39 | 0.55 | 0.70 | 0.85 | 1.09 |
| 4.77 | Cu% | .. | 12 | .. | .. | .. |
| | Sn% | .. | 88 | .. | .. | .. |
| 7.15 | Cu | 45 | 18 | 16 | .. | .. |
| | Sn | 55 | 82 | 84 | .. | .. |
| 9.54 | Cu | 89 | 41 | 26 | 22 | 22 |
| | Sn | 11 | 59 | 24 | 78 | 78 |
| 11.93 | Cu | 95 | 67 | 37 | 29 | 27 |
| | Sn | 5 | 33 | 63 | 71 | 73 |
| 14.40 | Cu | 95 | 70 | 44 | 33 | .. |
| | Sn | 5 | 30 | 56 | 67 | .. |

The copper content in the electrodeposit increases with increase in the copper content of the plating solution and decreases with increase in the c.d. At constant c.d., the percentage of copper increases with increase in temperature, decrease in total pyrophosphate content of electrolyte and by agitation.

Alloy deposits analysing 12-95% copper (88-5% tin) have been obtained by varying the operating conditions. The deposits (on copper, brass or platinum) are quite adherent, smooth, fine-grained and silvery-white, yellow to red in colour depending upon the ratio of copper to tin. With steel as basis metal, they are not as adherent. The throwing power of the solution is good and the deposits do not change in appearance during a period of 2 to 3 months in the laboratory atmosphere.

Our thanks are due to Prof. K. R. Krishnaswami for his keen interest in the investigation.

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Indian Institute of Science, T. L. RAMA CHAR.

Bangalore-3,

April 10, 1953,

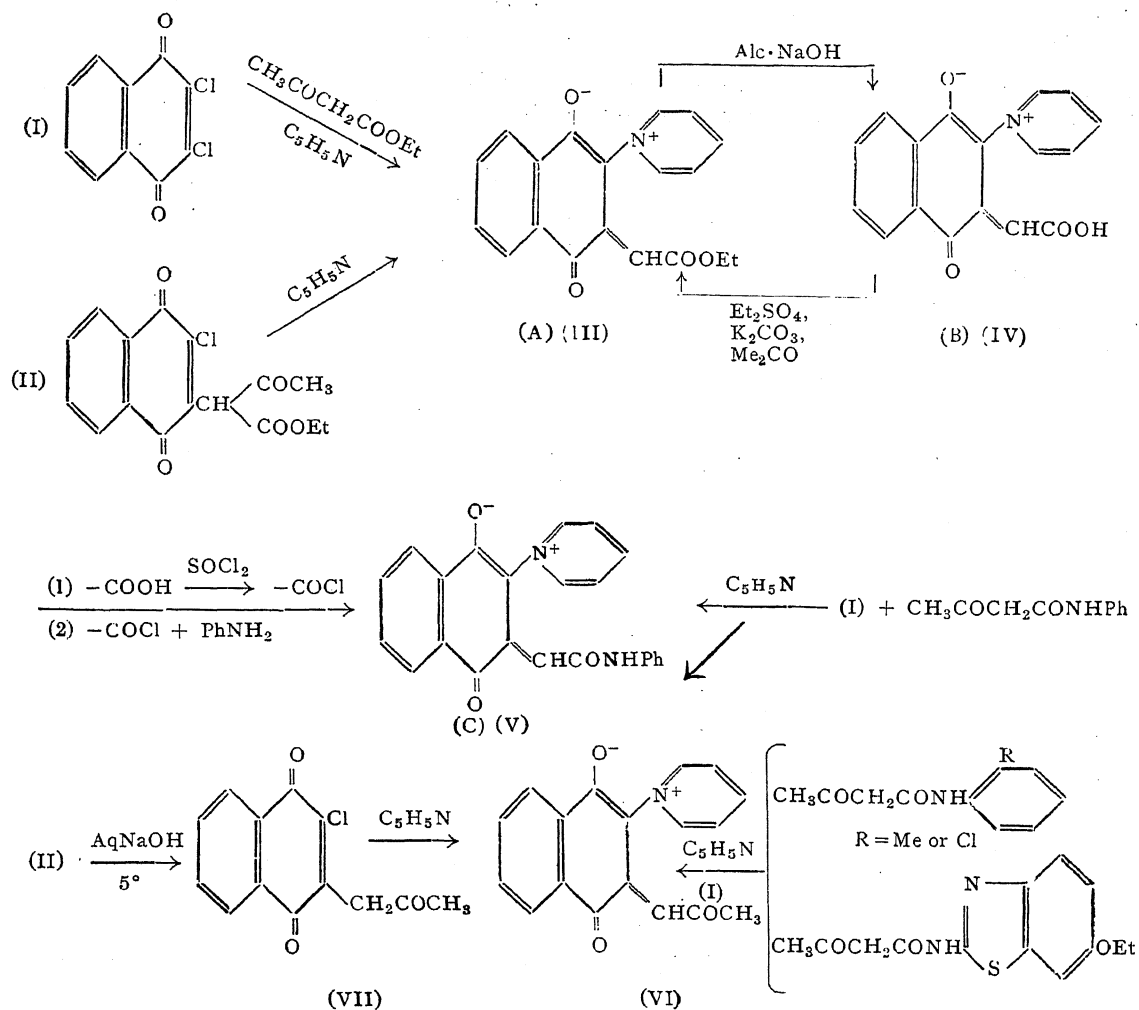
1. Tin Research Institute (England), *Working Instructions for Speculum Plating*, 1952. 2. Singh and Siddhanta, *J. Ind. Chem. Soc.*, 1949, **26**, 471. 3. Faust, *Trans. Electrochem. Soc.*, 1941, **80**, 301. 4. Field and Weill, *Electroplating*, Chapter 23. 5. Bennett, *Trans. Electrochem. Soc.*, 1913, **23**, 257. 6. Vaid and Rama Char, *Curr. Sci.*, 1952, **21**, 310. 7. Rama Char and Co-workers (*Unpublished work*). 8. Bandes, *Trans. Electrochem. Soc.*, 1945, **88**, 263. 9. *Electroplating*, 1948, **1**, 523.

PYRIDINIUM BETAINES FROM 2:3-DICHLORO-1:4-NAPHTHOQUINONE: A NEW TYPE OF VAT DYES

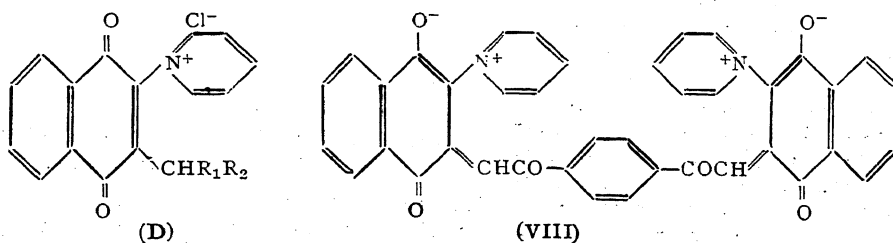
SYNTHESIS of vat dyes by the condensation of 2:3-dichloro-1:4-naphthoquinone (I) with azoic coupling components has been recently reported by us.¹ The condensation of (I) with ethyl acetoacetate and acetoacetarylides in pyridine to give deeply coloured pyridinium betaines is now described. Some of the compounds are useful vat dyes.

Reaction of (I) with ethyl acetoacetate in alcoholic sodium ethoxide to give the yellow-coloured compound (II) and a red-coloured bye-product has been reported.² Condensation in pyridine, however, yielded compound (A) (orange needles from ethanol, m.p. 154-55°), which was different from the above products. Elementary analysis and properties (*vide infra*) indicated that (A) is constituted as (III). This was further confirmed by the following facts:— (1) Reaction of (II) with pyridine gave (A). (2) Hydrolysis of (A) gave an acid (B) (violet needles from acetic acid, m.p. 307-08°). (3) Acid (B) on re-esterification gave (A). (4) Acid (B) gave the anilide (C). (5) Compound (C) was also obtained along with (VI) from the reaction of acetoacetanilide with (I) in pyridine. Compounds (A), (B) and (C) are, therefore, unambiguously constituted as (III). (IV) and (V) (Chart I).

Condensation of acetoacetanilide with (I) in pyridine gave violet needles (pyridine), m.p. 255-57° and red needles (aq. pyridine), m.p. 203-05°. The former compound proved to be identical with compound (C) (V) described above. The constitution of the second product then follows as (VI). Compounds (V) and (VI) are obviously formed by hydrolysis of an intermediate product such as (D). This proved to be correct because condensation of (I) with three different acetoacetarylides: acetoacet-o-chloranilide, acetoacet-o-toluidide and 2-acetoacetamido-6-ethoxybenzthiazole (Naphtol AS-L4G), with (I) in pyridine gave



Condensation of (I) with Naphtol AS-LG [terephthaloyl-bis-acet (2:4-dimethoxy-5-chloro) anilide] and Naphtol AS-L3G [terephthaloyl-bis-acet (2-methoxy-4-chloro-5-methyl) anilide] in pyridine also gave a common reaction product (red needles from quinoline which do not melt up to 360°), which is


$$\begin{aligned} R_1 &= -\text{COCH}_3 \\ R_2 &= \text{H}, -\text{COOEt} \text{ or } -\text{CONHPh} \end{aligned}$$

constituted as (VIII) on the basis of its elementary analysis and properties.

The above compounds represent a new type of vat dyes. Compounds (V) and (VI) dye pale pink shades, but (VIII) gives an attractive reddish orange shade on cotton from a bluish violet alkaline hydrosulphite vat (Fastness: Light, 6-7; Chlorine, 4-5; Severe washing, 4).

In view of the antimutagenic activity of naphthoquinones³ and their general physiological activity, the biological activity of the above and related compounds will be examined.

Further experiments in connection with this work are in progress and a detailed account will appear elsewhere. We are grateful to Professor Wilson Baker for helpful comments.

Dept. of Chem. Tech., B. SURYANARAYANA.
University of Bombay, B. D. TILAK.
Bombay-19,
February 17, 1953.

1. Tilak *et al.*, *Proc. Ind. Acad. Sci.*, 1953, **37A**, 81-103.
2. Michel, *Ber.*, 1900, **33**, 2402. 3. *Rep. Brit. Emp. Cancer Campgn.*, 1947-1951.

ROLE OF pH IN THE XYLENE EXTRACTION METHOD FOR THE ESTIMATION OF ASCORBIC ACID

IN the course of a study of the changes in ascorbic acid in canned fruit and fruit juices preserved with sulphur dioxide, we had occasion to employ the indophenol-xylene extraction method with suitable modifications to allow for interfering substances like sulphhydryl compounds, reductic acid, reductones, stannous and ferrous salts.¹ Using formaldehyde and hydrochloric acid for condensation of sulphur dioxide, xylene to extract the excess dye and a Summerson-Klett photo-electric colorimeter to measure the intensity of the pink colour of the dye, it was observed that the scale readings decreased with time due to the fading of the colour. This occurred when the dye followed by the xylene was added directly to the sample of sulphited squash. In this case, acetate buffer was not added as in the usual procedure for the estimation of ascorbic acid by the xylene extraction method.

A detailed study of the rate of destruction of the pink colour of the dye using a photo-electric colorimeter, 520 m μ filter and a number of reagents generally employed in the extraction of ascorbic acid and elimination of interfering substances, such as 2 per cent. metaphosphoric acid, 3N sulphuric acid, 3N hydrochloric acid, 8 per cent. acetic acid, 2 per cent.

oxalic acid, etc., showed that the rate of destruction is very rapid with the higher concentration of the acids. The destruction of colour by 8 per cent. acetic acid was the least. The pH of the reaction mixtures ranged from 1.10 to 2.30. Using a reaction mixture of 5 ml. water, 2 ml. dye (1 ml. dye = 0.1037 mg. ascorbic acid) and 0.1, 0.25 and 1.0 ml. of 3N HCl, at room temperature of 24°C., nearly half the colour was destroyed in 2, 1 and ½ minute respectively. The rate of destruction of the colour in citrate-phosphate buffers of range 3.0, 4.0, 5.0 was, however, very slow and was almost negligible during the first 3-5 minutes. The blue colour of the dye did not change to pink at pH 6.0. These results indicate the great importance of the adjustment of the pH of the reaction mixture in the xylene extraction method for the estimation of ascorbic acid, since during the interval between the addition of the dye to the sample and the subsequent addition of xylene to extract the remaining dye, however quick the additions may be, there is destruction of some of the dye, especially when the pH of the reaction mixture is below 2.0. At pH 3.0 to 5.0, there is very little destruction of colour during the first 30 to 60 seconds. It is, therefore, essential to adjust the pH of the reaction mixture to at least 4.0 for the estimation of ascorbic acid by xylene extraction procedure. Robinson and Stotz¹ also recommend the addition of acetate buffer of 4.0 to the sample. Our experiments have adduced independent evidence to indicate the importance of the adjustment of the pH of the reaction mixture to obtain correct values for ascorbic acid in preserved fruits and vegetables using the xylene extraction method. In the direct titration method, however, the interference by pH even at low ranges is negligible, especially when the dye is run from a burette into the sample.

Details of this investigation will be published shortly.

Division of Fruit Tech., G. S. SIDDAPPA.
C.F.T.R.I., BALDEV SINGH BHATIA.
Mysore,
March 19, 1953.

1. Robinson, W. E. and Stotz, E., *J. Biol. Chem.*, 1945, **60**, 217.

LAKSHADIA FICI GREEN, AND ITS COLOUR DIMORPHISM

KUMAR GUPTA¹ recently observed a lac insect on *Ficus religiosa*, showing red and yellow forms. The first to record such an observation

was Col. Adams who found it also on *F. religiosa*, at Marwar, in Rajputana, about 1896. The second record is from Monghyr, in Bihar, where Walsh had such lac collected again from *F. religiosa*, which ultimately induced Green to name the insect *Lakshadia* (*Tachardia*) *fici*. That was just before 1901. In 1925 I published a paper wherein the lac insect, cultivated in Kashmir on *Acacia catechu*, was identified as *L. fici*. In 1937, I² tried to show the identity of the Rajputana insect, subsequently illustrated by Negi of Ranchi, to be *L. fici* and the same as previously observed by Adams. Since the description of Green has appeared no other writer in India has used the designation *L. fici*. It is high time to point out what Sir G. Watt³ wrote so clearly in 1901. "It is quite likely therefore that India may possess more than two species and that this circumstance may account for certain discrepancies in the observations of Indian writers that have puzzled practical planters." Other references to literature would be found in my paper.²

Dept. of Biochemistry, S. MAHDIHASSAN.
Cipla Labs., Bombay-8,
April 16, 1953.

1. *Curr. Sci.*, 1953, 22, 49. 2. *Ibid.*, 1937, 6, 159.
3. Watt, G., *Agri. Ledger, Lac and the Lac Industry*, 1901.

MICRO-DETERMINATION OF HYDROGENATION-IODINE NUMBER OF VEGETABLE OILS

HYDROGENATION-IODINE numbers (H.I.N.)¹ of ten vegetable oils as well as of maleic acid, mono-methyl fumarate and methyl oleate have been determined using "Towers" micro-hydrogenation apparatus.

The experimental procedure consists in saturating the catalyst (10-15 mg.) suspended in glacial acetic acid (5 ml.) in one of the two reaction flasks having the side arm, the second flask serving to conduct the blank experiment with the solvent only. The material (10-20 mg.) under examination is weighed in a small tube and held in the side arm of the reaction flask out of contact with the solvent and catalyst inside. After the catalyst is saturated, the substance is dropped into the flask and the hydrogenation is carried out at room temperature until no more hydrogen is absorbed. In the case of tung oil, hydrogenation has been conducted at 50-60° C.² The amount of hydrogen absorbed at room temperature and atmospheric pressure is converted into standard conditions of temperature and pressure and H.I.N. calculated by means of the following equation:

$$\text{H.I.N.} = \frac{v \times 253.84 \times 100}{22412 \times w}$$

v = volume of hydrogen absorbed in ml.
at N.T.P.

253.84 = weight of two atoms of iodine

22412 = volume in ml. of 1 mol. of hydrogen
at N.T.P.

w = weight of sample in gram.

The hydrogenation-iodine numbers thus obtained have been compared with the iodine values determined by Hubl's and Wijs' methods. In the case of the tung oil, only low iodine values could be obtained although the estimation has been repeated more than a dozen times.

The simplicity and reliability coupled with the possibility of working with micro-quantities should warrant wide use of this method for the determination of unsaturation in oils and fats.

Full details will be published elsewhere.

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N. L. NARAYANA MURTHY.

B. H. IYER.

Dept. of Organic Chemistry,
Indian Inst. of Science,
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March 30, 1953.

1. Kaufmann, H. P. and Baltes, J., *Ber.*, 1937, 70, 2537. 2. Pack, F. C., Planck, R. W. and Dollear, F. G., *J. Amer. Oil Chemists Soc.*, 1952, 29, 227.

A SUITABLE MEDIUM FOR THE ENRICHMENT OF YEASTS

ROUTINE methods present considerable difficulty in isolating yeasts from such natural habitats as the intestinal tract of normal human beings, ripening fruits, sea-water, etc. A new method has been found suitable for the purpose, the details of which are briefly indicated below.

Enrichment of the yeasts was accomplished by the use of a liquid medium of the following composition in gm. per 100 ml. of distilled water: $(\text{NH}_4)_2\text{SO}_4$, 0.05; KH_2PO_4 , 0.05; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.01; $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, 0.002; $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, 0.001; yeast extract (Oxoid), 0.1; saccharose (even commercial sugar will do), 10. It is clear from the above composition that the high concentration of sugar, lack of organic nitrogen and the presence of acid phosphate in the medium would have an adverse effect on the development of most of the heterotrophic bacteria. Moreover, the application of the now widely used anaerobic glass-stoppered bottle enrichments further cuts down those aerobes which would find the medium less un-

favourable. It may also be mentioned here that incubation at 37° C. was found to be uniformly suitable for securing the results.

Ordinarily, two successive transfers of the originally inoculated bottles through the same medium kept under anaerobic conditions was found to be adequate; thereafter, the enrichment culture could directly be surface-spread on aerobic plates of 2 per cent. dextrose yeast extract agar (with mineral base only) or on the solidified enrichment medium itself to obtain well isolated colonies made up almost entirely of yeasts. The cultures so obtained could then be purified by any of the methods available for the purpose.

By the application of the above method, it has been possible to isolate yeasts from 23 of the 25 specimens of normal human faecal matter examined²; likewise, 3 out of 5 trials made to isolate yeasts from the ripe fruits of *Achras sapota* L.^{3,4} have also been successful. Correspondingly, only 7 times in the former and only once in the latter case did the routine culture method prove successful. Isolation of yeasts from the marine sources has also been found easy by this method as compared to the routine culture method¹ wherein mould growth tends to overwhelm that of yeasts and renders the isolation of the latter difficult or even sometimes impossible.

It is hoped that this method would be given a trial in other habitats wherein yeasts could be seen but not isolated with the ease with which they should be.

St. Xavier's College,
Bombay,
January 19, 1953.

F. X. LOBO.
SUMAN PATHAK.
NAFISA KACHWALLA.
J. V. BHAT.

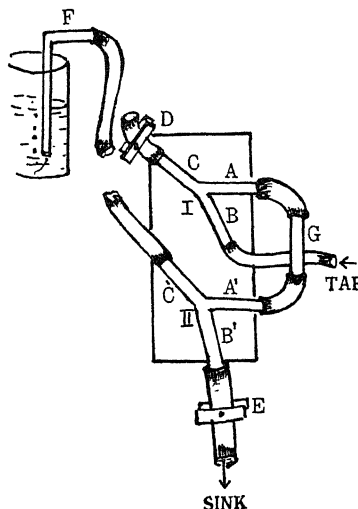
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A SIMPLE APPARATUS FOR AERATING NUTRIENT MEDIUM FOR ISOLATED ORGANS*

DR. DE¹ has described an apparatus for aeration of the nutrient fluids for isolated organs, especially, gut, uterus, etc. His recommendation of the substitution of air for oxygen is economical, particularly when a large number of experiments are to be conducted by students.

In this article, a simple apparatus is described which can be easily fitted up in any labo-

ratory. The requirements are two glass Y-tubes (4 mm. and 5 mm.), a straight glass tube (4 mm. × 7.5 cm.), a 4-mm. thick, L-shaped glass tube, one end of which is drawn into a fine nozzle, two small screw clamps, a small wooden plank (8" × 1½" × ¼") with smooth surfaces and sufficient length of stout rubber tubing.



The Y-tubes (I and II) are arranged as shown in the figure, the smaller ones being placed above. The corresponding limbs of the Y-tubes are parallel to one another. The limbs A and A' are horizontal. The stems C and C' are at about 135° C. to the horizontal. The limb A is connected to the limb A' by rubber tubes with the straight tube (G) interposed. Limb B is connected to the water tap. Limb B' is the outlet for water and is attached to a rubber tube which is led to the sink situated at a lower level. This acts as a suction. The screw clamp (E) is attached to this rubber tube so as to regulate the flow of water outside into the sink, and this manoeuvre, in turn, regulates the flow of air into the limb C'. A short rubber tube with screw clamp (D) is attached to the limb C. This screw clamp helps to adjust the air vent. The limb C' is attached to a long rubber tubing to the other end of which is attached the L-shaped tube (F), through which air is bubbled into the nutrient fluid.

By adjusting the two screw clamps, the amount of water let into the limb B, and the tilt of the plank to the vertical, most of the air can be made to pass through the limb C' with very little of water being carried over with it to contaminate the nutrient fluid. The

same purpose is served by having a larger Y-tube for II. If needed, a small bulb may be blown at the junction of A', B', C'. The draught of air in the straight tube is adjusted by the inflow, screw clamp D and the tilt of the plank. Once this is adjusted, it should not be varied. The number of bubbles can be varied by adjusting the screw clamp E.

The advantages of this apparatus are: (1) It can be easily made; (2) The aeration is continuous; and (3) The apparatus may be used in any experiments requiring constant bubbling of air.

My thanks are due to Dr. V. Iswariah for his valuable advice.

Dept. of Pharmacology, M. N. GURUSWAMI.
Madras Medical College,
Madras, December 24, 1952.

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ADRENOCHROME—PHYSIOLOGICAL INVESTIGATIONS

THE various therapeutic uses claimed for adrenochrome and its derivatives, led to our present work, which aims at explaining their therapeutic actions on a sound physiological basis.

In a few preliminary experiments with dogs (anaesthetised with paraldehyde), the animals were found to stand intravenous doses upto 20 mg. per kilogram body-weight, without appreciable alterations in blood pressure and cardiac rate. When adrenochrome was perfused through isolated heart of kitten, there was, however, a lowering of the heart rate and the amplitude suggesting a parasympathomimetic action.

The effect of adrenochrome on isolated segments of intestine of kitten was studied by suspending the segment in Ringer-Dale solution in an apparatus similar to Dale's bath and recording the movements (Fig. 1). The effect was compared with those obtained with acetylcholine and adrenaline. When dilute solutions of adrenaline (1 in 10 million) was used in the bath, the relaxation of the muscle during the first three minutes was followed by an acetylcholine-like response. With a solution of adrenochrome (1 in 100,000), the acetylcholine-like response was obtained within 30 to 45 seconds without the preliminary relaxation noticed with adrenaline. If, along with adrenochrome, choline chloride, hexose-monophosphate or sodium pyruvate was added to the bath solution, the acetylcholine-like response became more marked. Similar findings noticed by Minz and Plotka,^{1,2} were explained by them as being due to the formation of acetyl radicals from carbohydrate breakdown products uniting with the choline in the intestinal tissue leading to the formation of acetylcholine. They detected the presence of acetylcholine formed in the bath fluid by the contractions produced in the dorsal muscle of leeches, pre-treated with physostigmine. The present authors, however, perfused the fluid through the isolated heart of kitten to detect the presence of acetylcholine. It was also noticed by the present authors that the addition of acetylcholine along with adrenochrome led to greater increase in the tone of the muscle and the activity also lasted longer than with either of the compounds added separately, thus resembling the effect of eserine when added with acetylcholine.

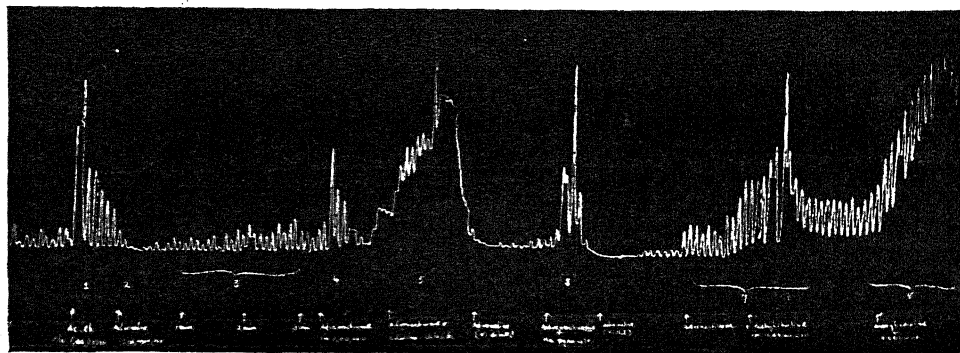


FIG. 1. Effect on intestinal movements. 1. Acetylcholine (1 in 10 million); 2. Adrenaline (1 in 10 million); 3. Effect of adrenaline after 1 min., 2 mins, and 3 mins.; 4. Adrenochrome (1 in 100,000); 5. Adrenochrome and Choline Chloride; 6. Adrenochrome and Sodium Pyruvate; 7. Adrenochrome and Acetylcholine (1 in 100 million) and 8. Acetylcholine (1 in 100 million) and Eserine (1 in 10,000).

These results suggest that the acetylcholine-like effect seen at the end of three minutes with adrenaline is due to the formation of acetylcholine in the intestinal wall and that the compound responsible for that formation is adrenochrome, derived from the oxidation of adrenaline. The fact that adrenochrome is structurally related to rubreserine (a physostigmine breakdown product), which also has an inhibitory action on choline esterase activity, suggests that adrenochrome brings about this acetylcholine-like effect, not only by the production of acetylcholine in the walls of the intestinal tissue, but also by inhibition of choline esterase activity.

The clinical application of adrenochrome as an A.C.T.H. stimulator *in vivo* has been recently published by one of us (V. S.) the *Lancet*³ and a comment on the same by Van Cauwenberge and Lecomte⁴ also appeared in the same journal in January, 1953.

Further work is in progress.

Dept. of Physiology,
Madras Medical College,
Madras,
February 14, 1953.

V. SRINIVASAN.
P. I. GEORGE.
D. V. S. REDDY.

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NUTRITIONAL REQUIREMENTS OF *PASTEURELLA SEPTICA*

VERY little information is available in the literature about the growth requirements of *P. septica*. Berkman¹ reported that several strains grew on a hydrolysed gelatin medium, when nicotinamide and pantothenic acid were added. Jordan² observed that, besides these two

factors, thiamine was essential for the mouse strain of *P. septica* investigated by her. Working at this Institute, Das and Rawat³ found that two Indian strains of the organism failed to grow in a casein hydrolysate medium containing nicotinamide, pantothenate and certain other growth factors and that the addition of serum or an extract made from liver, kidney or muscle was necessary. The present investigation has shown that these biological products can be replaced entirely by synthetic growth factors. Further, all the factors have been classified into three groups, *viz.*, essential, stimulatory and dispensable on the basis of these studies.

The basal medium consisted of the following ingredients per 100 ml.: glucose, 1.0 g.; acid hydrolysate of purified casein, 2.0 g.; sodium chloride, 1.0 g.; potassium phosphate (K_2HPO_4), 1.0 g.; ammonium chloride, 0.6 g.; sodium acetate, 0.2 g.; magnesium sulphate, 0.16 g.; ferrous ammonium sulphate, 8 mg.; histidine, proline, phenyl-alanine, cystine and tryptophane, 10 mg. each. Each tube contained 2.5 ml. of basal medium and the total volume was made up to 5 ml. by the addition of growth factors and the necessary amount of distilled water. The accessory growth factors were added so as to give the following final concentrations (per 100 ml.): nicotinamide, calcium pantothenate, thiamine and riboflavin, 0.2 mg. each; pyridoxin and *p*-aminobenzoic acid, 0.1 mg. each; folic acid and vitamin B₁₂, 4 µg. each; adenine, guanine, uracil, xanthine, inositol and choline, 1 mg. each; glutamine, 0.8 mg.; hæmatin, 0.5 mg.; biotin, 1 µg.

Glutamine was sterilized by filtration. In other cases, sterilisation was effected by autoclaving at 15 lb. for 20 minutes. The reaction of the basal medium and of the supplements was adjusted to pH 7.5 before sterilization. Of the test organisms studied, *Past* 52 is a virulent

TABLE I
Classification of the growth factors for *P. septica*

| Strain | Essential | Stimulatory | Dispensable |
|--------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| P. 52 | .. Pantothenic acid and nicotinamide | Adenine, uracil, guanine, xanthine, glutamine, inositol, pyridoxin, <i>p</i> -aminobenzoic acid, vitamin B ₁₂ , folic acid, choline, biotin and hæmatin | Thiamine and riboflavin |
| P. 25 | .. Pantothenic acid, nicotinamide, adenine and uracil | Guanine, xanthine, glutamine, inositol, pyridoxin, <i>p</i> -aminobenzoic acid, vitamin B ₁₂ , folic acid, choline, biotin and hæmatin | Thiamine and riboflavin |

bovine (vaccine) strain and Past 25 is "avirulent". The virulence of Past 52 is being maintained by passaging it in hill bulls every three months. About 6,000 viable cells were employed in inoculating 5 ml. of the test media. The complete mixture was found to give better growth than plain broth. The indispensability or otherwise of the individual growth factors was determined by omitting them singly from the complete medium. In every experiment, three tubes were used for each treatment, one tube being left uninoculated. The tubes were incubated aerobically at 37° C. for 48 hours.

Growth was evaluated by estimation of the turbidity of the culture tubes after incubation. The turbidity was determined by Lumetron photoelectric colorimeter (Model 401-A) using filter 650. Uninoculated complete medium was used as blank. The results presented in Table I were based on the data of at least three experiments with each strain.

The authors' thanks are due to Shri. M. R. Dhanda, Head of the Division of Pathology and Bacteriology, for his kind interest throughout this investigation.

Indian Veterinary Res. Inst., T. P. BANERJI.
Mukteswar-Kumaun, R. MUKHERJEE.
September 19, 1952.

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A NEW INTERSPECIFIC CITRUS HYBRID

AMONG Citrus fruits, the citron *Citrus medica* and the acid lime *C. aurantifolium* have been in cultivation in India and the neighbouring countries from very ancient times. The lemon *C. limonia* is closely related to the citron and was included as a variety of *C. medica* by Linneas and by botanists like Roxburgh, Hooker and Brandis. It probably arose as a hybrid between the citron and the lime in Western India, and spread to the Mediterranean countries in the early centuries of the Christian era. Like the citron, it has purple tinted flowers and petioles that are not winged. The flowers of the lime are like those of the orange, white, in colour. It has winged petioles. There are, however, many intermediate forms between the lime and the lemon. One such is the "Malta lemon" (Fig. 1), sometimes incorrectly called "Malta lime". According to Bonavia (1890), the Malta lemon was introduced by him into

Lucknow in 1863. Malta lemon was introduced into Malabar from Burma by Sri. E. K. Raghavan in 1931.

It produces fruits all the year round, often in bunches of four and five, and is thus a heavy yielder and a most useful plant for the small gardens of Malabar. Seedless parthenocarpic fruits are the rule, but occasionally seeds are produced by open pollination.

Interspecific hybridization is a very common feature in the genus Citrus and has been responsible for the origin of many varieties which have been given the status of species by modern botanists. One such is the grape fruit *C. paradisi* which arose in the West Indies about 1814 as a hybrid between the sweet orange *C. sinensis* and the pommello *C. grandis*. To-day there are many named varieties of this popular breakfast fruit of the New World. They include diploids $2n=18$, triploids $2n=27$, and traploids $2n=36$ (see *Chromosome Atlas of Cultivated Plants*, by C. D. Darlington and E. K. Janaki Ammal). Another natural hybrid of importance is the Rough lemon, *C. karna*, which has become the universal stock plant in Citrus industry. It is considered to be a hybrid between the Sour Orange—*C. aurantium* and the lemon.

The giant "Mitford lemon" of Kew Gardens is probably also another interspecific hybrid between the lemon and perhaps the pommello (*C. grandis*). It is a diploid ($2n=18$). I collected Citrus fruits which closely resembled the "Mitford lemon" from Nepal in 1949. Seedlings of these are being grown at Kew for comparative studies.

Citrus hybrids come true from seeds because of the occurrence of vegetative embryony, a phenomenon very prevalent in the family Rutaceae. Chance embryos which are produced sexually give interesting segregates, from which new varieties are constantly evolving for selection by the Citrus breeder.

Thus, great possibilities lie before the plant breeder who wishes to develop hybrids between species of Citrus, as shown by the work of Swingle in America. Names like "Citrange" for the frost-resistant hybrid between the sweet orange and trifoliate orange (*Poncirus trifoliata*); "tangelo" (tangerine \times grape fruit or "pomelo"); "tangor" (tangerine \times orange) have crept into horticultural usage (Bailey, 1933). To these I add "Citrolemon" for a natural hybrid between the citron and "Malta lemon" which I found growing amongst a collection of both these plants in the garden of Sri. K. Sukumaran at Kausthubham, Shoranur, South Malabar.

The hybrid is intermediate in size between the citrus and Malta lemon (Fig. 1).



FIG. 1. Malta lemon (left); Citron (right) and the Hybrid (centre).

It has inherited the thick sweetish rind of the citron, and can therefore be used for the same purpose of candying and pickling as the citron. It resembles the Malta lemon in the production of fruit in bunches, four and five being common. Fruit exhibited at the local horticultural show received an award of merit. Cytological examination showed that both parents and the hybrid are diploid ($2n=18$).

Seed production is very abundant in the hybrid and seedlings are being grown for genetic analysis and the production of tetraploids by colchicine treatment. I have given the name "Sukumari" to this useful Citrus hybrid.

Botanical Survey of India, E. K. JANAKI AMMAL.
Calcutta,
April 18, 1953.

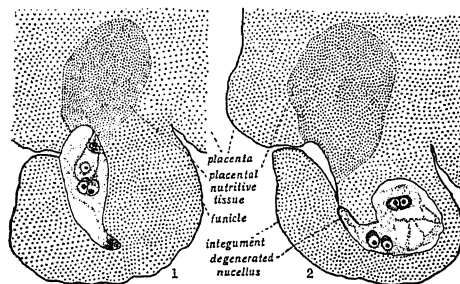
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HAUSTORIAL BEHAVIOUR OF THE CHALAZAL END OF EMBRYO SAC AND REVERSION OF POLARITY IN *UTRICULARIA FLEXUOSA* VAHL.

It is well known that the micropylar end of the embryo sac in *Utricularia* behaves as a haustorium. *Utricularia flexuosa*¹ resembles other species of the genus in this respect. The ovules, which are unitegmic, tenuinucellate and anatropous, are so oriented that the micropyle is directed towards the placenta. The apical end of the embryo sac, which develops according to the Polygonum type,¹ enlarges very rapidly. When the embryo sac is still at the four-nucleate stage of development, or

even earlier, it becomes naked due to the disappearance of the nucellar cells. The young embryo sac grows through the micropyle, extends beyond the ovule and comes in contact with the placenta. Later, its apical end is seen to have penetrated deeper and lies embedded in the placental nutritive tissue which is situated at the base of each ovule¹ (Fig. 1).

In one ovule, however, the condition observed was just the opposite of the usual. Although the embryo sac had attained the four-nucleate stage, its micropylar end was not enlarged. The degenerate remains of the nucellus, which are not seen at this stage, were still present, forming a cap at the micropylar end of the sac. This is obviously due to lack of enlargement of the upper end of the sac in this case. On the other hand, the chalazal end, which is usually small and narrow (Fig. 1), had become



FIGS. 1-2. *Utricularia flexuosa*. L.s. of ovules. A part of the placenta is included to show the placental nutritive tissue (densely shaded area) at the base of the ovules. Fig. 1. Ovule with mature embryo sac, showing haustorial behaviour of the micropylar end. Fig. 2. Ovule showing the four-nucleate stage of an embryo sac, the chalazal end of which has grown into the funicle and has become higher than the original upper end. $\times 210$.

extraordinarily enlarged. It had become curved and was seen extending towards the placental nutritive tissue through the funicle. It had advanced to such an extent that it was now situated at a higher level than the original upper end of the embryo sac (Fig. 2). This indicates that, in exceptional cases, the embryo sac may enter the placental nutritive tissue through the funicle instead of following the usual course. Although the embryo sac is only at the four-nucleate stage, the behaviour of the lower end recalls the condition in plants belonging to the Balanophoraceae^{2,3,4} and the Viscoidae.⁴⁻⁸ A strong probability is suggested that the reversion of polarity, seen at the four-nucleate stage in *U. flexuosa*, might have

extended to the mature stage of the embryo sac by the organization of the egg apparatus in the end which is now upper, but which was originally the lower or the chalazal end.

I am thankful to Mr. R. K. Bhattacharya, who prepared the slide from the material provided by me.

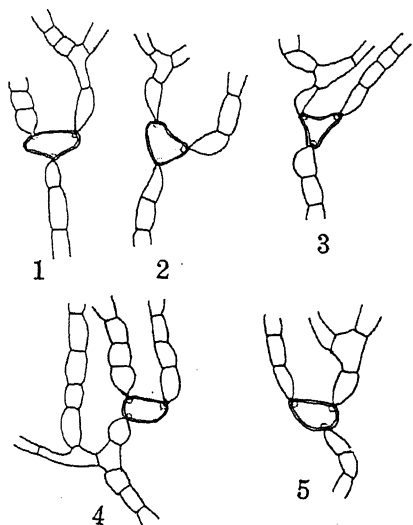
Dept. of Botany,
Aligarh Muslim University,
Aligarh, U.P.,
December 21, 1952.

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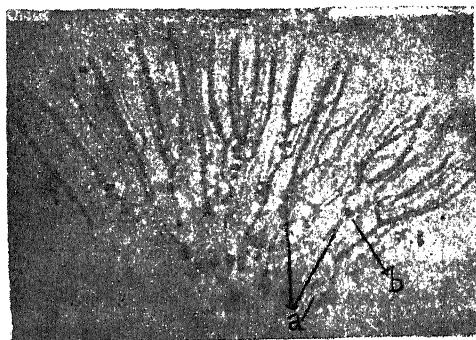
OCCURRENCE OF THREE-PORED HETEROCYSTS IN *BRACHYTRICHIA* *BALANI* (LLOYD.) BORN. & FLAH.

In the genus *Brachytrichia* heterocysts are usually intercalary. An ordinary intercalary cell in the trichome gets converted into a heterocyst. Such an intercalary heterocyst develops two pores, one on either side of it, i.e., where the former cell which got converted into a heterocyst was connected with its two adjacent cells of the trichome.

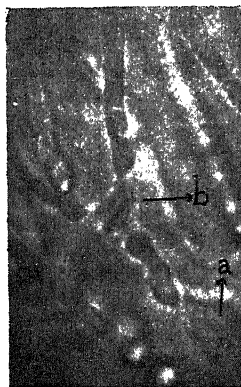


FIGS. 1-5. Filaments of *Brachytrichia Balani* showing three-pored heterocysts ($\times 640$).

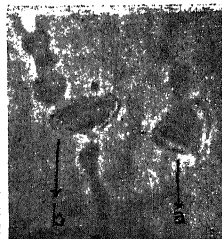
In some material of *Brachytrichia Balani* collected from Pamban, sometimes a cell in the main trichome which forms a branch (branch-bearing cell) becomes converted into a heterocyst. Since this cell is connected with three adjacent cells, viz., the two adjacent cells in the main trichome and the lowermost cell of the lateral branch, the heterocyst formed by this cell shows three pores one on each side on which it is connected with the three adjacent cells (Figs. 1-5 and Fig. 6). The occurrence of such three-pored heterocysts is very unique and interesting. One-pored and two-pored heterocysts are known among the Blue-green algae.^{1,4} But a three-pored heterocyst does not appear to have been recorded among any of the Blue-green algae. Several cases of three-pored heterocysts were found in the writers' material. These do not otherwise differ from the normal heterocyst of the alga, and have the same structure and appearance.



6



7



8

FIG. 6. Photomicrograph of a part of a thallus showing two-pored (a) and three-pored (b) heterocysts ($\times 220$).

FIGS. 7, 8. Photomicrographs of two-pored (a) and three-pored (b) heterocysts ($\times 865$).

They have a two-layered wall, the outer being thick and the inner quite thin. The nature of

the contents was normal and did not show any peculiarity. It may be stated here that in view of the fact that any normal vegetative cell can get converted into a heterocyst, there is nothing to prevent a branch-bearing cell of a trichome from developing into a heterocyst and forming three pores one on each of the three sides on which it is connected with its adjacent cells.

In this connection it would be interesting to note that in *Loriella osteophila* Borzi some of the heterocysts are formed at the point of forking (Ref. 2, Pl. VI, Figs. 1-5). This heterocyst would appear from the figures to be in contact with adjacent cells on three sides. But the heterocysts are shown as having only two pores. A re-examination of such heterocysts of the alga from this point is indicated. This alga has so far been recorded only from Papua.^{3,5}

University Botany Lab., M. O. P. IYENGAR.
Madras, T. V. DESIKACHARY.
May 13, 1953.

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ON THE VERNALIZATION OF TUBERS OF *CYPERUS ROTUNDUS* LINN.

Stout and healthy tubers of nut-grass were dug out and divided into two batches of 24 each, and stored separately in two bottles. 500 ml. of water was maintained in each so as to keep the tubers fully saturated. One of these bottles was kept continuously (in a Kelvinator) at a temperature of 7° C and the other in the shade at the ordinary atmospheric temperature as control.

After four weeks, the tubers were sown separately in four earthen flower pots. The pots were regularly watered to the extent of 1,000 ml. once a week. Hoeing of the pots was, however, regularly effected every Wednesday to maintain an optimum tilth of the soil.

Tubers in both the experimental and control pots germinated quite normally with a bias of earliness to the extent of 2-3 days in favour of the experimental. Subsequent performance of plants raised from the experimental tubers

were definitely superior to those of the control viz., they were taller, more vigorous and deeper green with broader leaf-blades. Besides, the plants from the vernalized tubers entered into the reproductive phase 30 to 31 days earlier than the control.

This little experiment, therefore, demonstrates that underground tubers, when subjected to low temperature, could be vernalized like seeds.

I am thankful to Sri. C. Lakshmanan for his help during this experiment.

Dept. of Botany, T. C. N. SINGH.
Annamalai University,
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OCCURRENCE OF A NEW SUBSPECIES, *OPALINA JAPONICA DHARWARENSIS*

THE *Opalina* described in this note was found in the rectum of the frog, *Rana limnocharis* from Dharwar and belongs to the beaked group, *Japonica*, since it has an abruptly pointed posterior end. The beak in this *Opalina* is similar to that found in the type species *Opalina japonica* Sugiyama, but differs from it in the following points.

(1) The nuclei are larger in size and spherical in shape; (2) The individuals are broader in form and more regularly shaped than those described in *O. japonica*; (3) Ranarum-like forms also met with in the same infection suggest the *Opalina* to be somewhat intermediate; (4) The body dimensions are distinctly larger.

For these points of differences the *Opalina* has been regarded as a new subspecies of *Opalina japonica* Sugiyama, and it has been named as *Opalina japonica dharwarensis*.

The description given for this new subspecies is based on studies both in its living condition as well as from the observations made from the smears fixed in Bouin's fluid and stained with Delafield's hematoxylin.

The figures have been drawn with the aid of a *Camera lucida*.

Opalina japonica dharwarensis nov. sub. sp.

Body is flat and thin. Anterior end is broadly rounded while the posterior tapers to an abruptly pointed end. The beak thus formed is not bent to one side like in *Opalina coracoidea* Bezz. In some individuals, this beak was found to be very much reduced or even absent. Such forms resembled the Ranarum-like forms. But their nuclei are smaller.

Therefore, the *Opalina* under study is an intermediate species and shows greater affinities to the *Japonica* group.

The thin ectoplasm is well marked off from the dense endoplasm. The spherical nuclei are uniform in size and are evenly distributed in the cytoplasm. The cilia are close-set, small and are of uniform length throughout the body-surface.

Body (length \times breadth) average, of 24 individuals, 203×159 microns. Nucleus (diameter) 4.5-5 microns. Length of cilia 6 microns.

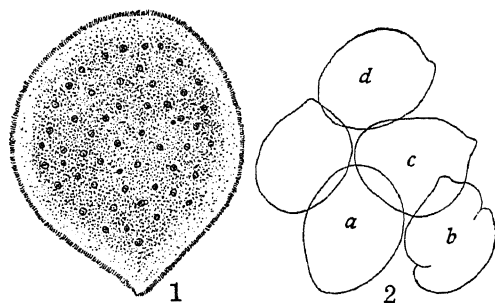


FIG. 1. *Opalina japonica dharwarensis* nov. sub. sp. in *Rama limnocharis* Wieg, from Dharwar.

FIG. 2. Individuals of the same under low power of microscope. Individual (c) is a *Japonica*-like form. Individuals (a) and (d) are *Ranarum*-like forms with reduced beak or none. Individual (b) is undergoing division.

The nearest species of this group, *Japonica* (Metcalf, 1923 and 1940) are:—*O. panamensis*, *O. drytonni*, *O. coracoidea* and *O. annandali*, the diagnostic features of which have been compared with the present new subspecies in the following table, in which all the dimensions are in microns.

| | Body (L \times B) | | Nucleus | | Cilia length |
|-----------------------------------------------|---------------------|------------------|-------------------------|----------------|--------------|
| <i>O. japonica</i> Sugm. | Oval, | 178 \times 104 | oval, | 4 \times 3.6 | 8 |
| <i>O. coracoidea</i> Bezz. | „ | 204 \times 120 | round | 3.5 | .. |
| | | | (beak bent to one side) | | |
| <i>O. panamensis</i> Met. | „ | 177 \times 115 | | 4.8-5 | .. |
| <i>O. drytonni</i> Met. | „ | 170 \times 120 | round, | 4-6 | .. |
| <i>O. annandali</i> Met. | rounded, | 128 \times 57 | oval, | 3.3 \times 2 | .. |
| <i>O. japonica dharwarensis</i> nov. sub. sp. | broadly rounded | 203 \times 159 | spherical, | 4.5-5 | 6 |

The writer thanks Dr. K. R. Karandikar for providing facilities during the course of this work.

Dept. of Zoology,
Karnatak College, Dharwar,
June 21, 1952.

J. C. UTTANGI.

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OCCURRENCE OF YOUNG MACKEREL, *RASTRELLIGER CANAGURTA* (CUVIER) OFF MADRAS COAST

THE occurrence of young mackerel, *Rastrelliger canagurta* (*Scomber microlepidotus* of Day, 1876) which we have noticed in large numbers on 21st and 23rd March and on 20th April 1953 in the shore-seine catches on the Madras Coast is worthy of record. It is not uncommon to find young mackerel along the West Coast of India in the months of July to September (Chidambaram *et al.*, 1952; Bhimachar and George, 1952; Panikkar, 1952). The spawning habits of the Indian mackerel are not fully understood, but it is fairly clear from the various observations of previous workers that the spawning period extends from May or June to September on the West Coast. Our observations seem to be the first on record showing that young mackerel occur during March-April period along the East Coast.

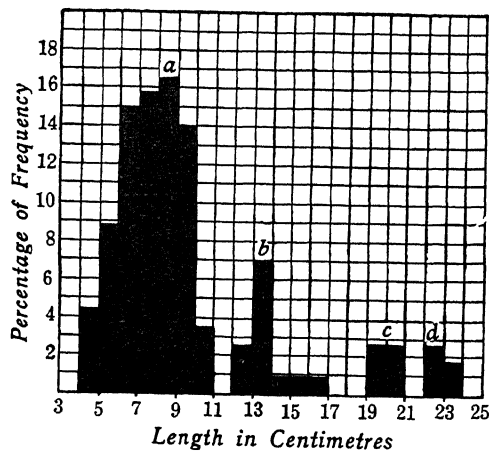


FIG. 1. Size-frequency distribution of the Indian Mackerel, *Rastrelliger canagurta* off Madras coast in March-April, 1953.

A fairly large sample of young mackerel was collected by us on 21st March 1953, when they were abundant in the shore seines amounting to 60-80 lb. in each haul. Another random sample of juvenile and adult mackerel was collected on the 17th of April 1953 from the boat-seine catches. These two samples were combined, and the whole was treated to represent the entire population of the species occurring in the inshore waters of the Madras Coast during the period of March-April under observation. It may be seen from the figure that the predominant size-group of young mackerel (a) is at 8-9 cm. in length, and the maximum and the minimum sizes noticed by us among this group are 10.3 cm. and 4.9 cm. respectively. The catch obtained in the boat-seines showed a wide variation in sizes ranging from 9.7 cm. to 23.4 cm. The juvenile and adult mackerel of the sample fall into three definite groups with peak values of 13-14 cm. (b), 20 cm. (c) and 22-23 cm. (d). There is a similarity in the occurrence of young mackerel from July to September following the south-west monsoon on the West Coast, and from March onwards following the north-east monsoon on the East Coast. One of us working at Vizagapatam on the East Coast has previously observed young mackerel varying from 10-14 cm. in June in both the years 1951 and 1952.

We are grateful to Dr. N. K. Panikkar for going through the manuscript and offering his valuable criticism.*

Central Marine Fisheries K. VIRABHADRA RAO.
Research Unit, S. BASHEERUDDIN.
Madras-5, April 22, 1953.

upper surface with characteristic oily appearance on the under-surface. The fully developed jet black spots measure 1.5 mm. in diameter and when numerous, coalesce to form irregular lesions surrounded by chlorotic areas. Veins are also infected. In severe cases of infection, the numerous water-soaked spots on the leaves give them the appearance of boiled leaves. Such leaves dry without showing chlorosis.

Description of the pathogen.—Rods, single or in chains of two, capsulated, motile with a single polar flagellum, measure $1.5 \mu \times 0.8 \mu$; non-spore former; on potato dextrose agar plates, colonies round with entire margins, smooth, shining, umbilicate, consistency butyrous, colour sulphur yellow (Ridgway) with no striation, colony diam. 1.1 cm. after 4 days; on nutrient agar plates, growth medium, flat, smooth, glistening with lobate margins, colour mustard yellow (Ridgway), colony diameter 1.1 cm. after 6 days; in nutrient broth, fair growth within 24 hours, gelatin liquefied; starch and casein hydrolysed; litmus reduced; nitrites not produced from peptone and potassium nitrate; hydrogen sulphide and ammonia produced; 3 per cent. sodium chloride tolerant; optimum temperature for growth 25° C. to 31° C., no growth between 5° C. and 13° C., thermal death-point 52° C.; pathogenic to hairy and glabrous varieties of *C. tetragonoloba*.

A detailed account will be published elsewhere.

Plant Pathological Lab., M. K. PATEL.
College of Agriculture, G. W. DHANDE.
Poona-5, Y. S. KULKARNI.
March 4, 1953.

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp P.O.

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BACTERIAL LEAF-SPOT OF CYAMOPSIS TETRAGONOLOBA (L.) TAUB.

Xanthomonas cyamopsidis sp. nov., the pathogen causing leaf-spot on *C. tetragonoloba*, first noticed at Patna (Bihar) and Khopoli (Bombay) in September, 1952, produces several small, circular, water-soaked spots (0.25 mm. to 0.5 mm. in diam.). The spots are found all over the lamina and are olive-coloured on the

NEW HOSTS OF THE DOWNY MILDEW OF CUCURBITS IN INDIA

ONE of the most serious diseases of cucurbits in India, as elsewhere, is the downy mildew caused by the fungus *Pseudoperonospora cubensis* (B. & C.) Rost. (*Peronosplasmopara cubensis* (B. & C.) (Berl.). In describing the parasite and explaining its persistence from season to season, Butler E. J. (*Fungi and Disease in Plants*, 1918, p. 313) states "the great diversity of climate and season in different parts of India and the frequency of suitable hosts would probably ensure the continuous growth of the parasite".

The number of hosts recorded for the fungus in India is comparatively small. There is no mention anywhere in India of cucumbers, *Cucumis sativus*, being infected. The disease was first noticed in Mysore by the senior author on a plot of cucumbers near Bangalore towards the end of November 1927. Later, in December

1952, it appeared in a severe form on cucumbers near Bidadi, about 23 miles from Bangalore. Soon the disease spread to water melons (*Citrullus vulgaris*), sweet melon (*Cucumis melo*) and bottle gourd (*Lagenaria vulgaris*). There is no record in the literature available of *Lagenaria vulgaris* being infected anywhere in the world, and so far as India is concerned this appears to be the first notice of the fungus on *Citrullus vulgaris*.

The infected vines are easily spotted on the field by the yellowish or partly dried up leaves. The spots can be readily made out when the young affected leaves are held up against the light. The nature of the fungus, and the measurements of the sporangiophores and sporangia correspond to those in literature. The sporangia are colourless when young, and purplish or violet when mature. They germinate readily in distilled water, either by putting forth germ tubes or by giving rise to zoospores. Oospores have not been noticed.

The early removal of the badly infected vines followed by spraying with 1 per cent. Bordeaux mixture prevented the spread of the disease.

Lab. of Plant Pathology,

Dept. of Agriculture,

Bangalore,

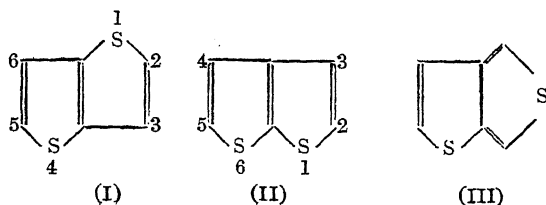
March 7, 1953.

S. V. VENKATARAYAN.

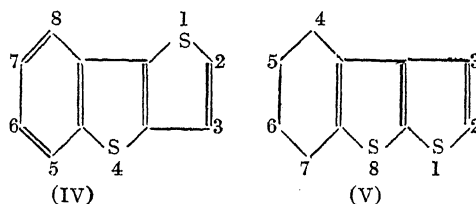
N. S. VENKATAKRISHNIAH.

SYNTHESIS OF THIOPHTHENES

THE synthesis of a solid and a liquid thienothiophene (Thiophthene) by the action of acetylene on molten sulphur has been described in the literature.^{1,4} The solid isomer was constituted as thieno(3:2-b)thiophene (I) because of its zero dipole moment and the liquid isomer was constituted as thieno(2:3-b)thiophene (II) because of its alternative synthesis from tricarballic acid or citric acid by the action of phosphorus trisulphide.² Whereas the zero dipole moment of the solid isomer confirms its structure (I), the liquid isomer may be constituted either as (II) or (III). The structures (I) and (II) assigned to thiophthenes have now been confirmed by unambiguous synthesis following the general method for the synthesis of thiophenes and thiapyrans described by us earlier.³



Condensation of 3-thiophenethiol with bromoacetaldehyde diethyl acetal in alcoholic sodium ethoxide solution gave 3-thienyl ω -diethoxyethyl sulphide, b.p. 115-20° (bath temp.)/1 mm. (2:4-dinitrophenylhydrazones, m.p. 113°). Cyclization of the latter with phosphorus pentoxide in boiling benzene gave (I), m.p. 55° (Challenger and Gibson⁴ give m.p. 54°) (picrate, m.p. 146°). 2-Thienyl ω -dimethoxyethyl sulphide, b.p. 120-24° (bath temp.)/1 mm. (2:4-dinitrophenylhydrazones, m.p. 115°), prepared similarly from 2-thiophenethiol and bromoacetaldehyde dimethyl acetal, gave on cyclization (II), b.p. 75-80° (bath temp.)/1 mm. (Challenger and Gibson⁴ give b.p. 224-26°) (picrate, m.p., 135-36°; Biedermann and Jacobson² cite m.p. 133°).



With the possible exception of thionaphthene (3:2-b)thionaphthene, other condensed ring systems containing (I) are unknown. None of the derivatives of (II) have likewise been reported. Thieno(3:2-b)thionaphthene (IV), m.p. 87-88° (*sym*-trinitrobenzene derivative, m.p. 135°) and 4:5:6:7-tetrahydrothieno(2:3-b)thionaphthene, b.p. 130-40° (bath temp.)/1 mm. (V) (*sym*-trinitrobenzene derivative, m.p. 106-07°) have now been prepared, starting from 2-bromocyclohexanone and 3-thiophenethiol and 2-bromocyclohexanone and 2-thiophenethiol respectively. The different steps in the synthesis of (IV) and (V) were similar to those employed by us earlier for the synthesis of dibenzothiophenes.⁵

Details of the work will be published shortly elsewhere.

Dept. of Chemical Technology, V. V. GHAIASAS.

University of Bombay,

B. D. TILAK.

Matunga, Bombay-19,

May 22, 1953.

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REVIEWS

Television. By F. Kerkhof and W. Werner. (Philips Technical Library, Eindhoven, Holland), 1952. Pp. 434. Available with Philips (India), Calcutta.

The reader of this book is assumed to possess a good knowledge of basic radio engineering. With such a background, he will quickly grasp the physical fundamentals of modern television circuits and of new circuits still to be developed. It is an advantage that the authors use exclusively the rationalised MKS system of units and avoid confusing terms such as "frame". Preference is given to the receiving side of television systems, but the essential features of transmitting and studio technique have also been mentioned.

The first 16 pages describe the basic principles of TV-transmission, involving scanning systems, propagation problems, and block-schemes of a transmitter and a receiver. An experienced radio engineer will immediately understand the difference between TV-technique and sound broadcasting technique.

Chapter II deals with the movement of electrons in electric and magnetic fields. The chapter begins with a theory of electron deflection. The basic electronoptical fundamentals of electric and magnetic focusing are only introduced thereafter. This procedure might present difficulties to readers not previously familiar with the science of electron optics. Some topics, like cycloidal movement or optical aberrations, could easily have been omitted. The rest of the chapter brings the fundamental equations for magnetic focussing and magnetic and electric deflection. Well-selected examples demonstrate the practical use of these equations for design problems.

A descriptive introduction to the physical principles of various types of pick-up tubes and picture tubes is the subject of Chapter III. It is followed by a chapter on the details of the TV signal as standardised in U.S.A. and Europe containing also an introduction to pulse transmission, D.C. restoration and pulse separation circuits. The excellent discussion of pulse top compensation by balancing the time constants of "grid leak resistance-coupling capacitor" on one side to the "load resistor-by-pass capacitor" on the other side will rarely be found anywhere else in the TV literature.

Chapter V is a successful attempt to explain

the basic principles of pulse technique and at the same time to insert as much design information as may help a beginner in TV circuit technique to check his designs numerically. To do this task in less than 50 pages is not easy. The authors have to be congratulated on their well balanced compromise between descriptive presentation and exact derivation of fundamental equations. A slightly more extensive use of waveform diagrams with typical numerical values of voltages and currents might be appreciated by practical designers.

Chapters VI and VII come up to a level which might not be expected in a general textbook on television and it is here that the reader most gratefully will observe the contribution of the authors to recent TV developments. The current time-base and the fly-back (or kick-back) EHT power supply are two problems of a TV receiver, which are still considered to be full of magic. They are generally dealt with in 3 to 4 pages even in up-to-date text-books. But here we find 52 pages of extensive treatment with plenty of extremely useful diagrams and design formulæ.

Chapter VIII on wide-band amplifiers constitutes the most valuable part of the book and even specialists in this branch will enjoy the more than 100 pages of carefully selected material. All types of amplifiers (video, carrier, single stage, multi-stage) with all possible kinds of frequency compensation are completely covered, using both approaches, frequency spectrum and time function.

Chapter IX could have been omitted, as so many text-books on radio or electric circuits cover the principles of transmission lines in the conventional form. Instead, it might have been more useful to extend Chapter X on aerials. The inclusion of more design data for wide-band receiving aerials, particularly in the *u.h.f.* range, would be welcome.

The optical fundamentals revised in Chapter XI, favouring the needs of TV-projection systems, will be very useful to many readers. The short pre-view (Chapter XII, 8 pages) on colour TV should not be missed. In the concluding Chapter XIII, all the previously discussed single circuits are composed to form a complete TV receiver. Two complete receiver diagrams with numerical values for all the components are discussed as examples. One is for

the British standard (positive modulation), the other for the Continental standard (negative modulation).

Sixteen highly instructive photographs from actual TV pictures taken under various faulty operating conditions conclude the excellent book, which can be strongly recommended to any radio engineer or technician, interested in learning the full details of the new art of television.

R. FILIPOWSKY.

Television Receiver Design. By A. G. W. Uitjens. (*Monograph 1, I. F. Stages.*) (Philips Technical Library, Book VIII A). Distributed in India by Philips House, Calcutta 20. Pp. 188 + 150 illustrations. Price Rs. 14.

This book is the first of a series recently started under the common title "Television Receiver Design" which again is part of the big series of Philips' books on "Electronic valves". Apart from this series Philips has already published the book *Television* by Fr. Kerkhof and W. Werner as a general introduction to the subject. Even the most careful study of this or any other book on TV principles leaves the reader with the desire for more detailed information on some of the subjects. The present series is intended to fulfil this need.

It is not accidental that the first book of the series deals with carrier wide-band amplifiers, primarily with TV-i.f. amplifiers. This branch of TV design technique is at least in its basis closely related to the conventional i.f. technique. However, the absolute values of the components involved and the design formulæ to be derived and used are considerably different from those familiar to a radio engineer.

The whole treatment is centred round the "gain bandwidth" produced, thus permitting a comparison between the various inter-stage coupling systems. TV-i.f. amplifiers in receivers involve generally 4 or 5 i.f. stages, as compared with only 1 or 2 in radio receivers. The problem of the multi-stage amplifier deserves, therefore, the greatest attention and the most perfect solution is presented by the "stagger tuned system" of amplifier design. Large parts of the book are devoted to it.

A valuable tool for evaluating TV-amplifiers is the step-function response, to which nearly the entire Chapter III (pp. 23-48) is devoted. Much new material, not published in book form anywhere else, is included in this section which, however, avoids excessive mathematics, and is suitable for the general reader.

The second half of the book deals with noise problems and feedback in an excellent pre-

sentation of the rather difficult matter. Many new details will be found in these 70 pages, specialists included.

A good appendix gives exact mathematical proofs to many of the newly introduced formulæ, besides a large number of charts and numerical data of the most frequently needed functions.

The book can be heartily recommended to all TV designers or engineers concerned with wide-band amplification in other fields.

R. FILIPOWSKY.

The Molecular Architecture of Plant Cell Walls. By R. D. Preston. (Chapman & Hall), 1952. Pp. xii + 211. Price 36 sh.

This book is mainly a connected account of the studies made by the author and his collaborators on the structure of plant cell walls. The first five chapters covering about half the book forms an introduction, giving the essential physics, chemistry and botany needed for a proper appreciation of this work. The treatment in these chapters is necessarily cursory, although a number of references are given which the interested reader may consult for more details. The studies are concerned with the nature of organization of cellulose chains in the wall structure of plant cells. Both X-ray and optical methods are used for this purpose, and it is interesting to read how the results of one can be used to supplement or confirm those obtained from the other. The use of crystal optics as an aid to the analysis of crystal structure has not been appreciated as much as it ought to be, and it is noteworthy that Dr. Preston has laid particular emphasis on the use of optical methods with polarized light in these investigations.

The detailed study of the orientation of cellulose chains throughout the area of a cell wall is a laborious process, but it does yield some very interesting results. For instance, the wall structure of a *Valonia* vesicle is found to consist of a cellulose spiral starting from a pole at one end and ending at the other end with cross striations throughout the length of spiral. In another alga, *Cladophora*, the cellulose chains form a criss-cross pattern, whose inclination to the axis of the plant stem varies in a characteristic manner from the base of the plant upwards. Another study deals with the angular dispersion of cellulose fibres in various woods. An excellent series of X-ray photographs have been obtained in this connection using spirals made from well-oriented artificial silk, which reproduce most of the effects actually found.

One is left with the impression that the contents of the book are more in the nature of a review of the author's researches, rather than on account of the subject as a whole. However, the book contains a large amount of valuable information, and botanists and physicists alike will profit by reading through it.

G. N. RAMACHANDRAN.

A Treatise on Physical Chemistry, Vol. II. (States of Matter.) Edited by H. S. Taylor and S. Glasstone. (Macmillan & Co., London), 1951. Pp. v + 701. Price 75 sh.

This is the second volume of the compendium on physical chemistry whose scope "was to be so broad that the student in a special field could garner from its pages that which was known as he set forth in his quest for the unknown". It deals with the kinetic theory of gases and the properties of both ideal and imperfect gas systems, the liquid state, the structure of solids as revealed by X-rays and the properties of matter in the colloid state. Each field is covered by specialists fully conversant with it, and the treatment is critical and thorough, while at the same time, brief and to the point. The discussion is not restricted to recent developments, although naturally they occupy the pride of place, but the whole subject is treated coherently from the beginning so that no other references need be made except for obtaining further information. The references to original literature seem to be comprehensive, although not exhaustive, the idea being probably that one could use those given as starting points for obtaining a complete bibliography. However, it is felt that a fairly complete list of the text-books and the more important reviews in each field should have been added to every chapter. Such a list is given for the Kinetic Theory of Gases and for the Colloid State, but is definitely needed in the chapter on X-ray analysis of the solid state.

There is no doubt that the aim of the editors stated earlier has been fully fulfilled and that in so far as the actual contents are concerned, this volume contains the most authoritative, up-to-date and comprehensive treatment that is available at present. Further volumes in this series will be eagerly awaited by chemists and physicists alike.

G. N. RAMACHANDRAN.

Typical Means. By K. Chandrasekharan and S. Minakshisundaram. (Oxford University Press), 1952. Pp. 139. Price Rs. 22-8-0.

This book inaugurates the series of Monographs on mathematics and physics launched by the Tata Institute of Fundamental Research,

Bombay, mainly for the use of research workers. It comprises some important work on typical means hitherto available only in research periodicals and forms a valuable supplement to the Cambridge Tract by Hardy and Rietz on the general theory of Dirichlet series. Written by two eminent mathematicians of this country whose own contributions in this field are quite significant, it is bound to acquire a distinguished place in the literature of summability.

An extensive theory has developed since the introduction of 'typical means' by Marcel Rietz more than forty years ago for the summation of divergent series. The book under review is a laudable attempt to give a systematic account of this development. It proceeds in four chapters, the first two of which are devoted to an exposition of the theory of typical means. Chapter I introduces the notions of summability by Rietz's typical means and of absolute Rietz summability due to Obrechkoff, and establishes, for the former, the first theorem of consistency, a limitation theorem and some Tauberian theorems. The analogue of the first theorem of consistency for absolute Rietz summability concludes the chapter.

Chapter II discusses the second theorem of consistency for Rietz summability with a classification of the different versions of this theorem due to Hardy, Zygmund and Hirst. Chapter III deals with the applications of the theory to Dirichlet series, giving Abelian theorems as well as some new converse theorems on the abscissa of summabilities, theorems on the behaviour of a Dirichlet series on the line of summability, Tauberian theorems for Dirichlet summability and many new theorems on the Dirichlet product of summable series. The last chapter is concerned with the application of Rietz's means to the study of spherical summation of multiple Fourier series largely due to Bochner and Chandrasekharan, and it is based on a formula of Bochner which may be regarded as a generalisation of the classical integral of Pejér. It commences with the notion of spherical summation of multiple Fourier series and series derived therefrom, leading to applications to summations over lattice points in k dimensions and to a solution of the problems of ordinary and absolute summabilities discussed in the case of single Fourier series by Hardy, Littlewood and others.

The printing and get-up of the book are excellent. The notes at the end of each chapter with references brought up-to-date compensate for the lack of an index and a bibliography.

T. S. N.

The Chemistry of Synthetic Dyes, Vol. II. By K. Venkataraman. (Academic Press Inc., New York), 1952. Pp. xv + 705-1,442. Price \$ 15.00.

Volume I containing the first 22 chapters was reviewed in an earlier issue of the *Current Science* (June 1952, p. 173).

Volume II is a continuation of Vol. I and contains Chapters XXIII to XLII and the index for both the volumes. Chapters XXIII to XXVI deal with diphenyl and triphenyl-methane dyes, xanthine and acridine dyes, azine dyes, and benzophenone, benzoquinone and naphthoquinone dyes. Appropriate to their importance, anthraquinone dyes of various categories occupy the following six chapters covering 200 pages of the volume. Indigoid dyes, solubilized vat-dyes, sulphur dyes and sulphurized vat dyes are dealt with in Chapters XXXIII to XXXVI. Then follow two interesting chapters on phthalocyanines and cyanine dyes. Chapter XL gives an account of "The Action of Light on Dyes and Dyed Fibres", Chapter XLI "Chemical Constitution of Dyes in Relation to Substantivity" and Chapter XLII "Identification, Analysis and Evaluation of Dye Stuffs". A critical and interesting account of chromatography is included in the last Chapter.

Among the special features of the volume, the following may be mentioned: (1) The volume is eminently readable; (2) Though the scope of the book is to deal with the chemistry of synthetic dyes, other interesting properties of these dyes and related substances such as medicinal and bacteriostatic properties and uses are also described; (3) A very good account is also given of the naturally occurring groups of compounds related to synthetic dyes, such as flavones, xanthenes, naphthoquinones and anthraquinone derivatives; (4) Particularly informative and lucid accounts of the properties and reactions of various groups of compounds and the comparative merits of different dyes are presented.

The index which comes to 90 pages is quite comprehensive. The printing is uniformly good and the reviewer could see only one blemish on page 821. There is no doubt that the two volumes provide a comprehensive account of the chemistry of synthetic dyes in a lucid and critical manner and constitute an essential addition to chemical literature worthy of all libraries, institutional as well as private.

T. R. S.

Ferrous Analysis (Modern Practice and Theory). By E. C. Pigott. (Chapman & Hall, Ltd., London), 1953. Pp. 690. Price 84 sh.

The author's standard text-book on "Chemical Analysis of Ferrous Alloys and Foundry Metals", has been entirely re-written and doubled in length to form the present comprehensive work.

Section I reviews the main quantitative techniques comparing gravimetric, volumetric, colorimetric, polarographic and spectrochemical methods, which incorporate two detailed chapters dealing with photoelectric absorptiometry and spectrography and reports the most recent development upto the direct reading spectrograph.

In Section II the most common methods of analytical determinations are compiled for 31 constituents occurring as alloying elements or impurities in iron and steel. The selection is fairly complete and only a few elements are missing, such as calcium and magnesium, out of which the latter one has gained importance in the production of nodular cast iron. The chapter provided for each element is introduced by brief remarks about its recovery and its effects in iron and steel. This gives a useful guidance to the analytical chemist regarding the usual concentrations of the constituents. A discussion of the chemical properties and of the procedures for qualitative approach follows. The descriptions of the methods for quantitative determination are supplemented by an explanation of the basic theories and always note very carefully the time required and the accuracy attainable. Such data although very helpful, are frequently omitted in other analytical handbooks because of uncertainties. The simpler and more recent methods for oxygen and nitrogen determination are not included. Each chapter concludes with a bibliography of ferrous analysis research published since 1930. This section represents the most comprehensive part of the book taking 486 pages.

Section III devoted to microchemical analysis describes the special equipment and the methods for micro-determination, further specific spot reactions, examination of unisolated inclusions and finally micro-analysis of isolated inclusions. The very recent attempts to investigate into the compositions of isolated carbides and nitrides are not yet considered.

Section IV reporting on the analysis of ferro-alloys, iron ores, aluminium and copper alloys and Section V reporting on the analysis of refractory materials should only be regarded as an extract from a more extensive field.

Out of the four appendices the one concerning the rapid analysis of ferrous bath samples is of practical interest. Regarding the time required for determination of phosphorus and sulphur, agreement exists with common steel plant experience. For silicon, the time indicated is too large, while for carbon and manganese, it is smaller than what is generally achieved.

The book is designed both for the practising analyst and the advanced student and may definitely be estimated to serve this purpose well. It forms a valuable addition to the existing literature on metallurgical analysis and hence can be recommended to all interested in the subject.

H. SCHRADER.

Electrical Units, With Special Reference to the M.K.S. System. By Eric Bradshaw. (Chapman & Hall, Ltd.), 1952. Pp. 64 + 9 figs. Price 9 sh. 6d.

The first two chapters contain a review of the essential mechanical units and the notions of primary units and derived units. The important classical systems, viz., the C.G.S. electrostatic system of units, and the C.G.S. electromagnetic are then considered and the M.K.S. rationalized system is introduced as an extension of the practical units. In order to explain the advantages of this system, the main steps in the establishment of the basic relations of electrotechnics have been outlined by the author. He recommends the adoption of the primary units: metre, kilogram, second and ampere, but suggests that all derived electrical units may be conveniently described in terms of A, V, m and sec., or derivatives of these. Conversion tables, copious examples from electrical engineering, and a brief reference to two-dimensional field plotting, help to clarify certain ideas about fields and the associated units of measurement and emphasize the value of a rationalized (particularly the M.K.S. rationalized) system of units. The publication is a further recommendation of the "Rationalized M.K.S. or Giorgi System of Units" advocated by the reviewer, for which he has suggested the simple name "Electrical Units".

R. W.

Progress in the Chemistry of Fats and Other Lipids, Vol. I. Edited by R. T. Holman, W. O. Lundberg and T. Malkin. (Pergamon Press, Ltd., London), 1952. Pp. 186. Price 42 sh.

This volume is the forerunner of "completed and projected manuscripts to be published in the form of an annual Progress Series". The five articles in the volume were originally intended for a new edition in English of the

Heffer-Schoenfeld "Chemie und Technologie der Fette und Fetteprodukte", a project which had to be abandoned due to the untimely death of Dr. Schoenfeld. These are: 'The Molecular Structure and Polymorphism of Fatty Acids and Their Derivatives' (T. Malkin); 'Sterols' (Werner Bergmann); 'Structure and Properties of Phosphatides' (P. Desnuelle); 'Chromatography of Fatty Acids and Related Substances' (R. T. Holman); and 'Derivatives of the Fatty Acids' (H. J. Harwood).

No doubt, most of the material covered by the above articles has already appeared in greater detail in recent text-books by Bailey, Danel, Markley, Ralston and Wittcoff. However, these articles offer an up-to-date but concise survey of the subjects, and their value has been increased by a critical appraisal of the work done so far, trend of recent research and suggestion for further work in the fields concerned.

Several typographical errors are noticed in the book which otherwise is neatly printed and bound. Authors' names have been arranged alphabetically under "References" only in one chapter out of five. Names under "Name Index" give cross-references to names under "References" and not to the text proper. Considering that the book has only 186 pages, the price is somewhat high.

J. G. K.

Mass Spectroscopy in Physics Research, Proceedings of Symposium held in September, 1951. (National Bureau of Standards Circular No. 522). (Order from Government Printing Office, Washington 25, D.C.). Pp. 273. Price \$ 1.75.

During the past decade, mass spectroscopy has assumed an important role in both physics and chemistry for research and analytical work. Although several chemistry conferences have touched on these topics, the Bureau's Symposium on Mass Spectroscopy in Physics Research provided physicists with their first comparable opportunity to discuss advances in mass spectroscopy, particularly interesting to them and to derive thereby the longer range benefit of personal contacts with leading workers in this field.

Papers presented by outstanding physicists from many laboratories throughout the United States and ten other countries at this symposium are included in this volume, and in most cases a fairly complete record of the discussions following the papers is given. Thus, the circular summarizes a decade of work in mass spectroscopy and its use in physics research.

Botany of Sugarcane. By C. Van Dillewijn. (*Chronica Botanica*, Waltham, Mass, U.S.A.), 1952. Pp. xxiii + 371. Price \$ 6.00.

This book from the pen of a veteran worker on sugarcane is a comprehensive compilation of the present stage of knowledge about this plant. It is divided into two sections—one dealing with morphology and anatomy, and the other with physiology. The author has adopted the method of literally citing salient parts of original articles and dividing and subdividing the contents to facilitate quick reference. But it is obvious that such a method would allow little scope for critically evaluating divergent findings in the light of the experience of the author, and often gives an air of finality to findings which subsequent work has failed to uphold.

In the section of botany (constituting one-fifth of the book), a chapter might have been added on taxonomy of sugarcane and other species of *saccharum* so often referred to, and on allied genera, *viz.*, *Erianthus*, *Narenga*, *Sclerostachya* which together are known as wild *saccharums*. The subject of "Inflorescence" also deserved a more detailed treatment. Physiology of sugarcane has been treated comprehensively, with well-written chapters on various important aspects giving all that one needs to know in outline. Trace elements, however, have not received the attention they deserve and certain elements, such as zinc and molybdenum, find no mention at all. A chapter on physiology of flowering would have enhanced the value of the book and one would have also liked to find a mention of "pith" and "cavity" and an empirical formula for determining size of leaf, besides a list of important varieties (past and present) grown in different countries along with their parentages.

The book is written in lucid style and is profusely illustrated with useful graphs, diagrams and histograms supplemented by numerous tables and an exhaustive bibliography. It is on the whole, a herculean effort on the part of the author who deserves the gratitude of workers in sugarcane for compressing such a vast amount of knowledge into one book of moderate size. It will doubtless prove useful as a reference work both in laboratory and field investigations on sugarcane, and should most legitimately find a place in the library of all research institutions and on the shelf of all workers connected with problems of sugarcane and its cultivation. Its austere and elegant get-up is of a piece with its contents.

K. L. KHANNA.

Physiology of the Fungi. By Virgil Greene Lilly and Herace L. Barnett. (McGraw-Hill Book Co., New York), 1951. Pp. xii + 464. Price \$ 7.50.

The present volume bears sufficient evidence of the influence of biochemistry on the study of the fungi. A little more than two-thirds of the book is devoted to the biochemical aspects of the problem, perhaps at the cost of the systematics of fungi.

The book opens with a brief introduction explaining the scope and aim of the authors in this project. The earlier chapters relate to culture media and growth. This is followed by the biochemical aspect detailed in the next eleven chapters under enzymes, essential elements, etc. The physiology of the fungi is dealt with in the last five chapters, with special reference to sporulation, spore germination, physiology of parasitism and inheritance, and variation.

The appearance of the present volume is timely, and the able handling of all the topics makes the book a useful addition to all students in this field of fungi.

T. N. R. RAO.

Books Received

Code for Protection against Lightning. (N.B.S. Handbook No. 46 of 10-12-1952.) Pp. x + 88. Price not given.

Blood Cells and Plasma Proteins. Edited by James L. Tullis. (Academic Press Inc., New York, N.Y.), Number 2, 1953. Pp. xxii + 436. Price \$ 8.50.

Advances in Cancer Research, Vol. I. Edited by Jesse P. Greenstein and Alexander Haddow. (Academic Press Inc., Publishers, New York). Price \$ 12.00.

Field Experimentation with Fruit Trees and Other Perennial Plants. By S. C. Pearce. (Technical Communication No. 23 of the Commonwealth Bureau of Horticulture and Plantation Crops, Farmhouse, Bucks, England). Pp. x + 130. Price 10 sh.

Radio Engineering, Vol. 2. By E. K. Sandeman. (Chapman & Hall, Ltd., 37, Essex Street, London W.C. 2), 1953. Pp. xxii + 612. Price 55 sh.

Essays in Marine Biology. (Richard Elmhirst Memorial Lectures). (Oliver & Boyd, Edinburgh). Pp. viii + 144. Price 12 sh. 6d. net.

Soil Blocks. (John Innes Leaflet No. 12). (Oliver & Boyd, Ltd.), Feb. 1953. Pp. 8. Price 9d.

Sound. By Singh and Prakash. (Kishore Publishing House, Parade, Kanpur), 1952. Pp. viii + 319. Price Rs. 7-8-0.

SCIENCE NOTES AND NEWS

Wax Plates for Reconstruction of Models from Serial Sections

Shri. H. Swarup, Zoological Laboratories, Saugar University, Saugar, writes as follows: Among the substances used for the reconstruction of models from serial sections, a mixture of bees' wax and paraffin wax (m.p. 58°-60° C.) in equal proportions was found most satisfactory. This mixture is heated till it begins to boil and is then poured over a clean sheet of glass, the surface of which has been coated with a very thin layer of glycerine. The glass plate is kept cool by a layer of cold water below it. While pouring the boiling wax, the following precautions are necessary: (1) The glass plate should be kept on a perfectly horizontal and smooth surface; (2) The same quantity of boiling wax should be poured on the glass plate every time; (3) Each time the boiling wax is poured, care should be taken that it spreads uniformly on a measured area of the glass plate. For a plate 1 mm. thickness and area of 300 sq. cm., 28 g. of wax was found necessary. *Camera lucida* sketches of sections are drawn directly on the wax plates and subsequently cut out with the help of a warmed needle. The cut out sections, after being placed one above the other, can be cemented by passing a hot scalpel round the cut edges. In this way, excellent, true-to-scale models can be prepared easily.

Absorption of Moisture by Plants from Dew and Fog

In a research report read at the meeting of UNESCO's Advisory Committee on Arid Zone Research which opened in Paris on May 11, Dr. F. W. Went, Director of the Earhart Plant Research Laboratory of the California Institute of Technology, reported the discovery that dew is an effective source of moisture and can be stored in the soil by certain plants. Working under a grant from UNESCO, Dr. Went and Mr. S. Duvdevani, of Israel, found that a plant that has wilted from lack of soil moisture can not only absorb sufficient water at night through the leaves to sustain it through a succeeding hot and dry day, but can actually excrete water through the roots into the soil and thus use the soil as a reservoir for moisture. With tomatoes, peas, sugar beats, squash and mint the amount of water thus passed to the soil in a

single night occasionally exceeds the weight of the plant itself. Studies are now continuing on other plant varieties to measure their relative efficiency. This discovery offers the possibility of successful vegetable growth in semi-arid areas that are subject to night fogs and dew, as is the case in some parts of Morocco. Dr. Went has recommended an intensive survey of the frequency and the amount of dew in all the semi-arid areas of the world, in order to test the efficacy of food production under dew.

Magnets from Superfine Iron Powder

Under the name Gecalloy, the General Electric Co., England, has developed a technique for making magnets from iron powder (1/1,000th the diameter of the finest radio iron powder). Gecalloy micropowder magnets can be made in a variety of shapes by the use of special press tools and power presses. Strength for strength, a Gecalloy magnet weighs only approximately half as much as a conventional steel magnet. The ability to mould magnets by processes akin to those used in plastic moulding, therefore, opens up the way for entirely new conception for electrical machines. As every individual particle can be insulated from its neighbour, the Gecalloy is in effect an insulator. There are thus no eddy currents when it is used in an inductive device.

Film on Dental Cement

A 16mm. film produced by the National Bureau of Standards and the Council on Dental Research of the American Dental Association demonstrates a new method of mixing silicate cements in a closed container whereby the maximum amount of powder is incorporated into a given quantity of liquid independent of atmospheric conditions. Actual restorations in the mouth demonstrate the value of these findings in dental practice.

This film may be obtained on loan or purchase by application to the Office of Scientific Publications, National Bureau of Standards, Washington-25, D.C., or the American Dental Association, 222, East Superior Street, Chicago 11, Illinois.

Molybdenum Disulphide as Lubricant

Pure molybdenum disulphide is being recommended for use as a dry lubricant since it is

capable of withstanding extremely high pressures without galling or seizing. In addition it is suitable for work at both high and low temperatures, at high speeds and in a vacuum. Unlike many other lubricants, it has good chemical and thermal stability and the lubricating properties appear to be unaffected in the range between -40°F. to 70°F. The values of the coefficient of friction of molybdenum disulphide fall between 0.05 to 0.095 while the corresponding values for graphite are 0.11 to 0.19.

Standard for Analysis of Iron and Steel

The Indian Standards Institution has brought out a standard, prescribing the analytical procedures for determining carbon, silicon, manganese, sulphur and phosphorus in iron and steel. In preparing this standard, the ISI Committee has kept in view the facilities available in the country for the necessary chemical analysis as also the technological methods followed in this field.

Radio-Telescope for Manchester

The world's largest radio-telescope is being erected at Manchester University's experimental station at Jodrell Bank, Cheshire. The telescope, which is expected to be ready for use by next year, is automatically provisioned to follow the course of the stars and may well be instrumental in compiling a new map of the heavens.

National Botanical Garden, Lucknow

The Council of Scientific and Industrial Research has taken over the Sikandrabad Botanical Garden of the U.P. Government at Lucknow, for developing it as a National Garden. Prof. K. N. Kaul, Professor of Botany, Government Agricultural College, Kanpur, has been appointed as its Director.

Light Ray to Lure Fish

Fish are known to be attracted by light, and the new combined sinker and lure represents the first attempt to exploit this attraction for commercial fishing. The device is in the form of a hollow brass sinker with a small chamber for a dry battery and bulb. There are two

apertures through which the light is beamed for a distance of several yards. It can function at a depth of up to about 400'. It was first tested during the Lofoten fisheries last spring with very encouraging results, reports the Norwegian Export Council. The cost of the light-ray fishing sinker is 30 shillings.

Institution of Chemists, India

An examination for the Associateship of the Institution of Chemists (India), Group A (Analytical Chemistry), will be held in November 1953. The last date for receiving applications for admission to the Associateship Examination is 31st July 1953. Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Botanical Society of Bengal

At the Seventeenth Annual General Meeting of the Botanical Society held recently, the following Office-bearers were elected for the year 1953-54: *President*: Dr. J. C. Sen Gupta; *Vice-Presidents*: Dr. K. P. Biswas and Prof. P. C. Sarbadhikari; *Hon. Secretary*: Sjt. Mridula Datta.

Indian Dairy Science Association

At the Sixth Annual General Body Meeting of the Association held recently, the following Office-bearers were elected for 1953: *President*: Sardar Bahadur Sir Datar Singh; *Vice-Presidents*: Dr. K. C. Sen and Mr. H. Holck-Larsen; *Joint Secretaries*: Dr. H. Laxminarayana and Mr. M. K. Sastry; and *Editor*: Dr. K. C. Sen.

In the essay competition held in 1952 (Subject: Production and Marketing of Ghee in India) Sri. K. P. Sinha and Sri. B. S. Baliga were awarded gold and silver medals (donated by Sri. G. W. Chandiramani, M/s. Sheile & Co., Bangalore), respectively for their essays.

Dr. Harold Lyons

Dr. Harold Lyons, Research Director, National Bureau of Standards, U.S.A., was recently honoured by the Washington Academy of Sciences, for his invention of the atomic clock, which is accurate to within 1 in 10^{10} .

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SOIL HUSBANDRY IN INDIA

SOIL husbandry in its widest sense includes not only measures to combat soil erosion which is assuming serious proportions in our country, but implies also a fundamental study of the various properties of the soil with a view ultimately to maintain its productivity at the highest possible level.

For soil husbandry to come into its own in our country, a two-pronged development would seem to be essential: the first is an assessment of the magnitude of the erosion problem based upon an All-India survey of soil and land utilisation; the second, an intensification of soil studies paying due attention to local conditions and potentialities and also to the urgency of the food situation in the country.

Data on soils and utilisation have been collected in the past by irrigation departments in the various States, by experimental stations in agriculture, by the Universities and other institutions. But such data have been confined to limited areas scattered in different parts of the country, and further, the techniques of classification used by the different agencies vary greatly. The need for an All-India Survey is therefore obvious, and such survey should be carried out by a Central Agency so that there is uniformity in regard to systems of

classification, surveying and mapping techniques, and above all, scientific terminology, so that results from the different areas may admit of comparison and co-ordination. Programmes of soil survey and testing of soils, which are at present being carried on by the various agencies, should be co-ordinated with the work of such a survey.

Though adequate basic data are lacking, it is clear that the losses in acreage and production due to soil erosion are considerable. Throughout India, on all sloping grounds not covered by forests or shrubby vegetation, and on agricultural land not properly terraced and embanked, erosion of the soil is always going on. Soil erosion assumes several forms. Sheet erosion, which occurs on flat cultivated lands having no plant cover is responsible for greater loss than all the other forms of erosion put together. It has been calculated that in the black cotton soil of Sholapur, Bombay, 133 tons of soil per acre are lost per annum. The most striking example of soil erosion in India are to be found south of the Jamuna in Budelkhand, in Central India, in Bihar, and in parts of Bombay, Madras and the Punjab. River bank erosion and sand deposition are assuming menacing dimensions in Assam and

West Bengal, where the rainfall is heavy. Wind erosion has also been responsible for the loss of valuable top layers of the soil in many areas. Thus, in the Indus Valley, recent deforestation in the Thal has allowed the wind to blow the soil away.

The causes of erosion are generally destruction of forests, shifting cultivation, deterioration of village pastures, and faulty methods of cultivation. The cure naturally is the restoration of vegetation in such areas to protect the soil from the erosive action of wind and water. This is secured by the afforestation of the upper catchment areas of rivers; proper and sustained management and care of both the village and reserve forests; limitation of flocks and herds to the number which vegetation can support; improved agricultural practices, such as terracing, levelling and contour bunding and proper systems of drainage.

Legislation as provided for in the Five-Year Plan is no doubt necessary and must be given effect to, if the erosion problem is not to become even more serious than at present; but quite as much, if not more, can be achieved by educating the public in regard to the social aspects of soil husbandry. Erosion is after all the result of man's misuse of land. It is his needs of timber and fuel, fodder and food, which have led to the destruction of the soil. Infusing a spirit of enlightened self-interest among the cultivators would, therefore, seem to be an urgent necessity. The cultivator must not only be convinced of the need for dealing with soil erosion; the State must also secure through right propaganda, his willing co-operation in regard to various measures to be adopted for proper husbandry of the soil.

A perusal of the Final Report of the All-India Soil Survey Scheme recently issued indeed convinces that fundamental studies on soils have not been lacking in our country. The major lines along which such studies have proceeded so far are: soil studies in relation to content of plant nutrients, and assessment of soil fertility, improvement of soil fertility and productivity, soil studies in relation to irrigation,

and soil classification, soil surveys and soil maps. But the authors of the Report have had to admit that the data so far obtained are rather scanty. Besides, even this very limited volume of work has been carried out mostly (with but a few rare exceptions relating to profile study) using old methods of approach. Most of the analytical data are confined usually to surface soils and in some cases only, to the sub-soils. Further, the sampling and analytical procedures are not always uniform. Excepting a few cases, the number of samples has been found to be too few for advisory work on matters of soil fertility.

The Report also recommends that in soil studies bearing on irrigation, more stress should be given to soil texture and soil profile, drainage, water requirements of crops moisture-holding and moisture-yielding capacity of soils. The information on the effect of micronutrient elements on crop yields and deficiency diseases of plants and animals can hardly be regarded as either adequate or satisfactory. It should form, as in other countries, a major line of investigation, because of the spectacular effect the micronutrients have shown on crop yield and curing of diseases of animals arising out of deficiencies in the fodder and food crops. Soil maps based on insufficient survey do not promise to be very helpful, although some useful attempts have been made in this direction by geologists and soil scientists.

Also, the effect of combination of fertilisers and their interaction requires to be studied more systematically. In view of the importance of the micronutrient elements, their effect should also be included in the manurial trials.

Considering that the basis of our national economy is agriculture, perhaps it is only fair to remark that the status of soil husbandry in our country is not what it should be at the present moment. But, there are indications—the formation of a Soil Conservation Society of India being one,—that a realistic approach is being made both by the scientists and the Government to face the issue and bring it to a successful conclusion.

SYMPOSIUM ON REINFORCED CONCRETE

A SYMPOSIUM on 'Reinforced Concrete in India To-day', is to be held at Roorke, under the auspices of the Central Building Research Institute, during November 11-13, 1953. The Organising Committee invites engineers, scientists, designers and contractors, to take part in the symposium. Those contributing

papers are requested to send a summary of the same to the Director, Central Building Research Institute, before August 15th, 1953. The envelope should be marked clearly "SYMPOSIUM". A detailed list of subjects to be discussed at the symposium can be had on request.

GLUTAMIC ACID AS AN INDUSTRIAL CHEMICAL

B. V. RAMACHANDRAN

National Chemical Laboratory, Poona

GLUTAMIC ACID has been known to students of protein chemistry for nearly a century, but it emerged out of the laboratory and became a chemical of commercial importance only in recent times. At present the production of glutamic acid amounts to millions of pounds annually. In 1948, the production in the U.S.A. of sodium glutamate was 6.2 million pounds, while the installed plant capacity was estimated at twice this figure.¹ Before World War II, Japan, which was the chief centre of production, manufactured about 9 million pounds; smaller quantities appear to have been produced in China also. Most of the production goes into the manufacture of processed foods, where it is utilised for its remarkable property of stabilising natural flavours.

Glutamic acid, $\text{HOOC}\cdot\text{CH}_2\cdot\text{CH}_2\cdot\text{CH}(\text{NH}_2)\cdot\text{COOH}$, was discovered² by the German chemist, Ritthausen, in 1866, who isolated it from an acid hydrolysate of gliadin, the alcohol-soluble protein of wheat. The flavour and taste enhancing properties of glutamic acid were discovered by the Japanese chemist, Ikeda, who in 1908, found that the essential constituent of a certain sea-weed, *Laminaria japonica*, extensively used in Japan as a condiment was glutamic acid. Manufacture of the amino acid was begun in Japan under a patent dated 21st April 1909, and under trade names such as "Ajinomoto" (literally, enhancer of taste), glutamic acid became a common household article like salt and sugar.³ Considerable quantities were imported into America where interest in its production developed in the twenties. Much research and developmental work was found necessary before glutamate manufacture was established in the U.S.A. In addition to the fabrication of new corrosion-resistant materials for use with concentrated hydrochloric acid, this work also resulted in a new process which involved alkaline hydrolysis of beet-sugar molasses.⁴

OCCURRENCE AND PHYSIOLOGY

Glutamic acid occurs in combination in practically every protein. The richest sources are given in Table I.

The amino acid occurs in proteins in the form of its acid-amide, glutamine.⁵ The raw materials used for manufacture both in the East and in the U.S.A. are wheat and corn gluten from starch factories. Some quantity is also produced in the U.S.A. from beet-sugar molasses. Beet contains 0.06-0.12 per cent. of the amino

acid, the entire quantity of which is ultimately found in the de-sugared molasses known as "Steffens waste water".

TABLE I
Glutamic acid content of some proteins²²

| Source | Protein | Glutamic acid % |
|----------------|------------------|-----------------|
| Wheat gluten | .. Gliadin | 42.2 |
| " | .. Whole | 36.0 |
| Corn gluten | .. Zein | 36.0 |
| " | .. Whole | 24.5 |
| Milk (Cattle) | .. Casein | 22.0 |
| " | .. Lactoglobulin | 20.0 |
| Peanut | .. Arachin | 21.0 |
| Cottonseed | .. Globulin | 17.2 |
| Hemp-seed | .. Edestin | 17.7 |
| Blood (Cattle) | .. Albumin | 17.0 |
| " | .. Fibrin | 15.0 |
| Muscle | .. Myosin | 21.0 |
| Soya-bean | .. Whole meal | 18.4 |

TABLE II
Approximate glutamic acid content of some oilcakes*

| Oilcake | Glutamic acid % |
|------------|-----------------|
| Groundnut | .. 7.8 |
| Cottonseed | .. 7.5 |
| Hemp | .. 6.4 |
| Sunflower | .. 5.2 |
| Castor | .. 5.6 |
| Cocoanut | .. 5.0 |
| Linseed | .. 3.8 |

* Values calculated from the protein and glutamic acid content given in (21) and (22) of bibliography.

The mammalian organism is capable of synthesising glutamic acid, and for this reason, it is not one of the "essential" amino acids which have to be supplied by dietary protein. This fact is, however, definitely established only for certain species such as the rat. Chicks and probably humans require an external supply of glutamic acid for growth.^{8,9}

Glutamic acid plays a central role in intermediary protein metabolism on account of the many reactions it is capable of undergoing.¹⁰ The fact that most food proteins contain glutamic acid as a major constituent cannot be without significance.

A special function of glutamic acid is that it is the only amino acid which is oxidised in the brain.^{11,12} It is not known whether this property has any connection with its therapeutic use in the treatment of mental deficiency. It has been demonstrated by groups of workers headed by Zimmerman and Waelsch that the mental power of retarded children and adolescents is greatly improved by administration of glutamic acid.^{13,14}

USE AS FOOD FLAVOUR

The emergence of glutamic acid as an industrial chemical is not due to its biochemical functions or therapeutic action, but to its widespread use as a food flavour. Mono-sodium glutamate is used extensively as a condiment for enhancement of taste and flavour. Due to its balancing and blending effect it is added as an adjuvant in meats, sea-foods, soups and chowdars. The conclusion from the work of more than one taste panel^{16,17} is that mono-sodium glutamate not only combines all the four components of taste but gives, in addition, a tingling sensation which has been described as a "feeling of satisfaction". A remarkable property of glutamate is its seasoning and blending effect, rounding off sharp profile and suppressing certain undesirable qualities such as the sharpness of onions, rawness of vegetables, volatile characteristic of boiled rice and bitter tastes in certain other dishes. It is estimated that in the U.S.A. 2 million pounds are used in canned soup, an equal quantity in canned meat products, one million pounds in dry soups and one million pounds directly in restaurants. Some quantity is used in the beer industry also. There are indications that the armed forces are likely to be one of the important users of glutamic acid in the future. The monotony of military rations under field conditions is a serious problem and the Food Acceptance Branch of the U.S. Army has been keenly interested in research on glutamic acid with a view to its incorporation in canned rations.

MANUFACTURE

The preparation of glutamic acid in the laboratory is simple. A protein rich in the amino acid, usually wheat gluten, is hydrolysed with concentrated hydrochloric acid, the hydrolysate concentrated to a thin syrup and saturated with hydrochloric acid gas in the cold. Crystallisation of glutamic acid as the hydrochloride is almost quantitative after about 48 hours in the cold. In Japan, this process was used on an industrial scale, the high grade chemical stoneware manufactured in the country serving as a suitable corrosion-resistant material for the construction

of equipment. The raw materials used were wheat gluten and soya-bean meal.

The major portion of the U.S.A. production of glutamic acid is from corn gluten which is a by-product in the starch industry. A considerable portion is also produced from concentrated Steffens Waste, obtained by lime treatment of beet molasses, in which the amino acid is present to the extent of about 7.5 per cent. of the total solids.¹⁸

POSSIBILITIES OF MANUFACTURE IN INDIA

Press cakes of oilseeds are generally rich in proteins with a high content of glutamic acid (Table II) and any one of several oilcakes available in India can serve as a cheap raw material for the manufacture of glutamic acid, and incidentally, of other amino acids, as by-products, which have uses in the laboratory and in the pharmaceutical industry. Thus groundnut and cottonseed cake have about the same content of glutamic acid as the soya-bean meal much used in Japan as a raw material of this process.

Recent developments¹⁹ in the field of corrosion-resistant material have removed the chief difficulties in the use of concentrated hydrochloric acid for hydrolysis of oilcake protein and the isolation of glutamic acid as the hydrochloride. Specially noteworthy is the fabrication of hydrochloric acid-resistant equipment from carbon or graphite rendered impervious by synthetic resins. The use of these materials sold under such trade names as "Karbate" and "Impervite" have made the handling of concentrated hydrochloric acid easy and its recovery economical. With cheap raw material available, it should be possible to establish a flourishing glutamic acid industry in India which would supply the material not only for consumption in the country but also for export.

The author is indebted to Dr. M. Damodaran for the benefit of discussion and advice.

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NEW TYPE OF PENICILLIN

A SPECIES of *Cephalosporium* has been found to produce two different kinds of antibacterial substances. The first consists of a group of acidic antibiotics which are soluble in common organic solvents, are active mainly against gram-positive organisms, and show similarities to helvetic acid. The second consists of a substance (or group of substances) which is insoluble in most organic solvents, and is active against a number of gram-positive and gram-negative organisms. This has been called 'Cephalosporin N'. Evidence has now been obtained that cephalosporin N is a new type of penicillin.

The reasons for believing that the antibiotic is a penicillin are: (1) It was inactivated by preparations of the enzyme penicillinase in high dilution, and, like benzyl-penicillinase, it stimulated the adaptive production of penicillinase by suspension of *Bacillus cereus*. (2) It was rapidly inactivated at room temperature in

aqueous solution below $pH 4$ or above $pH 9$, and also at $pH 7$ in the presence of heavy metal ions such as those of copper, lead and tin. (3) Various chemical reactions yielded thiazolidine hydrochloride, penicilline hydrochloride, penicillaminic acid and glyoxal bis-2:4-dinitrophenyl hydrazone.

Cephalosporin N differs strikingly from the common penicillins in its hydrophilic character and its anti-bacterial activity. It behaves like an acidic substance on ion-exchange resins, and ionophoresis on paper shows that it carries a negative charge at $pH 6-7$. Also it appears likely that the activity of pure cephalosporin N against many gram-negative bacteria will be of the same order as that of benzylpenicillin. The relatively low activity of the antibiotic against gram-positive bacteria suggests that it reaches the sensitive parts of these organisms much less readily than the other penicillins.—(*Nature*, 1953, 171, 343.)

'DARAPRIM' IN TREATMENT OF VIVAX MALARIA

THE effects of pyrimethamine ("daraprim") on the clinical symptoms and also on the parasites in 30 cases of vivax malaria attending hospitals in Delhi State are reported by Jaswant Singh and collaborators of the Malaria Institute of India in a recent issue of the *British Medical Journal*. The clearance of symptoms and asexual parasites was more rapid in those who had a previous history of malaria than in those who had not. Though one must withhold judgment until reports on a large-scale and continued observations are available, daraprim seems to be remarkably effective against *P. vivax* in doses as small as 25 mg. The drug in all probability has a future and further work is indicated.

It may be mentioned that more recent reports from the U.S.A. show that the drug has gone through laboratory and field tests and found to be an anti-malarial of unusual scope and potency—perhaps the most effective agent discovered so far for the cure and suppression of malaria. It is claimed that the drug is 10 to 200 times as active as chloroquine, proguanil and mepacrine, the standard drugs in use at present for the treatment of malaria. It is reported that a 50 mg. dose of 'daraprim' is often sufficient to control the fever in acute malarial attacks and render the blood free from most strains of the disease, and that there are no after-effects.

COMMONWEALTH INDEX OF SCIENTIFIC TRANSLATIONS

THE British Commonwealth Scientific Liaison Offices in London are operating a scheme for a Commonwealth Index of Scientific Translations, and have appointed so far seven agencies in the Commonwealth countries. These agencies act in a liaison capacity and are responsible for collecting information about existing translations in that area for advising BCSO, London, of these, for the maintenance

of a central index of translation as also for assisting research workers in each area to obtain copies of translations requested by them and already prepared elsewhere. Scientific organisations are invited to participate in the scheme and to get into touch with the Ministry of Natural Resources and Scientific Research, New Delhi, who hold the agency for our country.

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ON EQUALLY-CORRELATED STATIONARY PROCESSES

A DISCRETE real stationary time series consists of a sequence of real numbers ordered in time, one observation corresponding to each of equally spaced time instants (denoted here by the integral variates n and s), obtained from populations $\{x(n)\}$ subject to (i) $E\{x(n)\} = m$, a constant independent of n and (ii) $E[\{x(n+s) - m\}\{x(s) - m\}] = R(n)$, a function of n only. An equally correlated process is a particular case, when

$$R(n) = \begin{cases} \rho^2 & \text{for } n = 0 \\ \rho^2 c & \text{for } |n| = 1, 2, \dots, p \text{ } |c| \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

That equally correlated stationary processes

exist is easily seen. For such processes, authors have proved the following:—

Theorem I.—The spectrum is absolutely continuous and is given by

$$\frac{1}{2\pi} [1 + c \{e^{i\lambda} + e^{-i\lambda} + e^{2i\lambda} + e^{-2i\lambda} + \dots + e^{pi\lambda} + e^{-pi\lambda}\}]$$

Theorem II.—The Hilbert space of the process is linearly non-deterministic, i.e., it cannot be fully linearly represented in terms of $x(n-1), x(n-2), \dots$ ad inf.

Theorem III.—The process cannot be Gaussian.

Theorem IV.—If observations are confined to $(p+1)$ consecutive ones, their arithmetic mean forms the best linear unbiased estimate of the process.

Andhra University, K. NAGABHUSHAN
Waltair, V. K. MURTHY.
May 13, 1953.

A MODIFICATION OF THE MODEL 50 PULSE GENERATOR

THE model 50 pulse generator described by Elmore and Sands¹ was built in this laboratory for testing standard electronic equipments used in nuclear physics experiments. However, in the final output stage, this was found to deliver a very large negative 'kick-back' along with the desired flat-topped positive pulse. Hence the

indebted to the Atomic Energy Commission and to the Scientific Research Committee of U.P. for the award of scholarships.

Physics Department,
Lucknow University,
April, 1953.

T. N. DAVE.

A. N. SAXENA.

1. Elmore and Sands, *Electronics*, Chapter 6, p. 320, McGraw Hill.

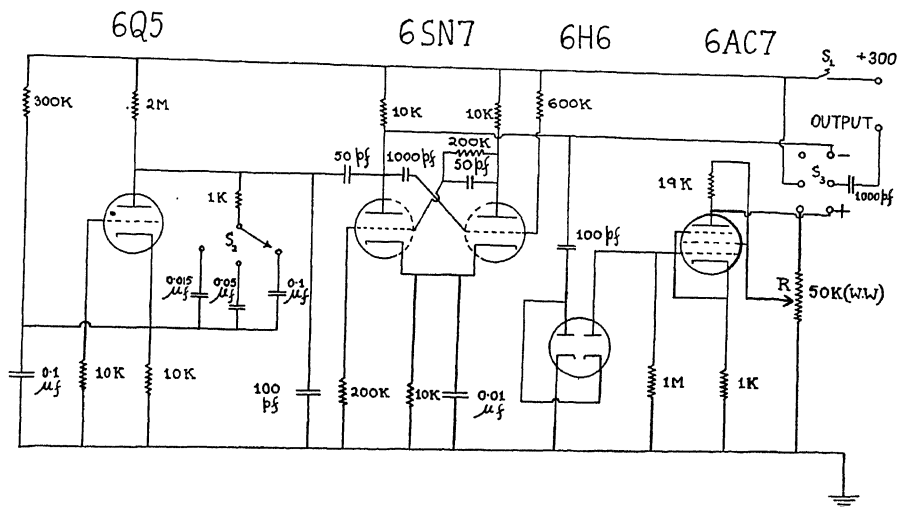


FIG. 1. Circuit Diagram of Pulse Generator

modified circuit shown in Fig. 1 was designed in which a double diode limiter of the series-shunt type has been employed to cut off the positive overshoot at the input grid of T_4 . This stops the negative 'kick-back' at the output of T_4 , which is due to the amplification of the positive overshoot at its input.

Either negative or positive pulses can be obtained from this circuit by means of a selector switch S_1 . Both positive and negative pulses are flat-topped with a sharp rise. The flat portion of each pulse is of 250μ sec. duration and the decay time is 100μ sec. The negative pulses have a constant height of 100 volts, while the positive pulses of adjustable height can be obtained by varying the potentiometer R , the range being 0-80 volts. However, in the low voltage region, approximately below 4 volts, the flat top of the pulse is accompanied by a very small kink. Efforts are being made to improve the pulse shape in the low voltage region. Different repetition rates can be obtained by means of the selector switch S_2 .

This pulse generator has been used satisfactorily in this laboratory for calibrating pulse amplitude discriminator.

The authors are indebted to Dr. S. N. Ghoshal for his interest and guidance. They are also

FORCE CONSTANTS OF CERTAIN DIATOMIC MOLECULES

RECENTLY Walsh¹ has plotted the force constant of a diatomic molecule formed between a group IV element (A) and a group VI element (B) against the force constant of the molecule formed between the same group IV element (A) and the group VII element (X) of atomic number greater by unity than that of (B). He has obtained a straight line passing through the origin for all the elements of the group IV, indicating that the two force constants are proportional independent of the fact that which group IV element forms the molecules. No numerical verification of the relation has been given by Walsh. However, a closer examination of the available data reveals that the ratio depends on the group IV element as shown in Table I. This ratio can be used for predicting the force constant of one such molecule, if the force constant of the other corresponding molecule is known. For completeness, the predicted values of five molecules of the series are also given in the same table marked with stars). K_0 is the force constant given by $4\pi^2\mu c^2\omega_0^2 = 5.8883 \times 10^{-2} \mu \omega_0^2$ dyne/cm., where the symbols have their usual meanings. The data for CF and CTe

has been taken from Rosen's *Donnés Spectroscopiques concernant les Molécules Diatomiques* (1951) and for the other molecules from Herzberg's *Molecular Spectra and Molecular Structure*, Vol. I (1951). The value for CTe is only approximate, and hence the predicted value for CI is also not very reliable. R denotes the ratio $K_a(AB)/K_a(AX)$.

TABLE I

| Molecule AB | $K_a \times 10^{-5}$ | Molecule AX | $K_a \times 10^{-5}$ | R | Mean R |
|----------------|----------------------|----------------|----------------------|-------|--------|
| CO | 19.02 | CF | 7.406 | 2.568 | 2.41 |
| CS | 8.488 | CCl | 3.766 | 2.253 | |
| CSe | 6.586 | CBr | 2.733* | | |
| CTe | ~4.95 | CI | ~2.05* | | |
| SiO | 9.246 | SiF | 4.892 | 1.89 | 1.887 |
| SiS | 4.938 | SiCl | 2.624 | 1.88 | |
| SiSe | 4.094 | SiBr | 2.214 | 1.892 | |
| SiTe | 3.13 | SiI | 1.66* | .. | |
| GeO | 7.526 | GeF | 3.925 | 1.917 | 1.896 |
| GeS | 4.359 | GeCl | 2.323 | 1.877 | |
| GeSe | 3.743 | GeBr | 1.971 | 1.894 | |
| GeTe | 2.776 | GeI | 1.464* | .. | |
| SnO | 5.615 | SnF | 3.277 | 1.713 | 1.759 |
| SnS | 3.536 | SnCl | 1.977 | 1.789 | |
| SnSe | 3.063 | SnBr | 1.726 | 1.775 | |
| SnTe | 2.439 | SnI | 1.386* | .. | |
| PbO | 4.556 | PbF | 2.63 | 1.732 | 1.777 |
| PbS | 2.992 | PbCl | 1.627 | 1.84 | |
| PbSe | 2.594 | PbBr | 1.449 | 1.79 | |
| PbTe | 2.086 | PbI | 1.194 | 1.747 | |

While the variation of this ratio R is not regular as we pass from C molecules to Pb molecules, it is found that the behaviour is very similar to the ionization potential V of the IVth group elements. As a matter of fact, $R \propto V^{3/4}$. The constancy of the ratio $R/V^{3/4}$ is shown in Table II.

TABLE II

| Group IV element | R | V | $R/V^{3/4}$ |
|------------------|-------|--------|-------------|
| C | 2.41 | 11.265 | .392 |
| Si | 1.887 | 8.149 | .391 |
| Ge | 1.896 | 8.126 | .394 |
| Sn | 1.759 | 7.332 | .395 |
| Pb | 1.777 | 7.415 | .395 |

The author is grateful to Dr. K. Majumdar for his guidance in the work.

Dept. of Physics, YATENDRA PAL VARSHNI,
Allahabad University, Allahabad,
April 22, 1953.

REMARKS ON A NOTE ON "DEVELOPMENT OF NOR'WESTERS ETC."

In the above note,¹ the authors state that "from the above, the authors are tempted to conclude that the advection of colder air between 10,000' and 20,000' and possibly also between 20,000' and 30,000' appears to be the final determining factor in the outbreak of nor'westers, at least when they are widespread".

In my note, 'Nor'westers in Bengal',² I have stated: "Above the height of 2 or 3 km., as before, the circulation is determined by the rear of a more northerly secondary low pressure area of the western disturbance. Colder air than what was existing previously at those levels must be flowing at those higher levels. When the 'cold front' of the secondary low pressure area reaches the given locality, both the favourable conditions and an initial cause of convection are present as in the U.P." after discussing the theoretical implications of earlier work. The diagram of the above note is also quite explicit.

In an earlier note³ I stated: "Fresh incursion of air at higher levels, colder than what existed previously would decrease the stability in the air along the vertical" (cf. also Fig. 2 of the note).

In Abstract No. 37, *Ind. Sci. Congress* (1937 Mathematics and Physics Section), I stated, "As the thermal distribution is not inherently unstable on days of thunderstorms, the causes that would initiate convection have been considered. Thunderstorms occur when the air at 2-4 km. is replaced by air potentially colder than what existed there previously."

In a paper entitled 'Dynamics of Thunderstorms',⁴ I stated: "From a practical point of view, the above discussion leads one to the useful conclusion in the case of heat thunderstorms: if at higher levels fresh air which is relatively cooler or potentially cooler than the one existed before. the conditions become favourable for thunderstorms".

The above earlier conclusions and references on the subject seem to have escaped the authors. In addition, I wish to point out that in 'Mechanism of Thunderstorms in the Tropics',⁵ where I have summarised most of my conclusions (the main data used were about nor'westers from isopleths drawn about cold pools of air at lower levels for the period 11th-16th March 1947). I have stated (p. 163), "Favourable air structure.—The rate of rise of potential temperature with height can be made small if one or both of the following two contingencies occur. (a) An incursion of colder or potentially colder air takes

place at levels from 3-6 km. An incursion of potentially colder air is possible if fresh air from a more northerly latitude is brought". The stress throughout the paper is for *advection currents* of fresh, cold and warm air masses. The diagram 2 b (p. 177) also shows it. Quite a number of other factors that enter into the pictures have also been discussed, may be with the use of the then available data but which merit reference.

Colaba Observatory, S. L. MALURKAR.
Bombay-5, April 30, 1953.

1. Ramaswamy, C. and Bose, B. L., *Curr. Sci.*, 1953, 22, 103. 2. Malurkar, S. L., *Ibid.*, 1949, 18, 5. 3. —, *Ibid.*, 1948, 17, 348. 4. —, *Proc. Ind. Acad. Sci.*, 1943, 18A, 20. 5. —, *Proc. Nat. Inst. Sci. Ind.*, 1949, 29, 162.

It is common knowledge among meteorologists that advection of colder air at high levels produces conditions favourable for thunderstorms. Mr. Malurkar has no doubt mentioned this in his papers but, as far as we are aware, he has nowhere proved by adducing synoptic and aerological evidence on specific dates that this upper level condition was actually responsible for the nor'westers, or that it was associated with western disturbances moving far to the north of India. We may also point out that the isopleths mentioned in the last para of his letter are in respect of *surface* temperatures and not upper air temperatures and that the diagram 2 b referred to by him is only a schematic diagram bearing no reference to the aerological situation on any particular day.

It is relevant to point out in this connection that we have brought out in our article, the following two points:—

(a) We have advocated the use of a ready and simple technique for detecting the advection of colder air over northern India and Pakistan during the nor'wester season.

(b) Using this simple technique on a number of specific occasions of widespread nor'westers and nor nor'westers, we have tried to give convincing proof of the advection of colder air between 10,000' and 30,000' on the days of nor'westers and suggested on the basis of this evidence that the upper level advection is probably the *final determining factor* in the development of nor'westers.

It is not correct to say that our investigations are based on data which were not available earlier. Our technique of analysis is based mainly on routine upper wind data which have been merely rehashed into a new form by means of a polar diagram.

Notwithstanding the above, we are thankful to Mr. Malurkar for specially drawing our attention to his papers and would assure him that they will be duly included in the list of references in our paper which will be published elsewhere.

Meteorological Office, C. RAMASWAMY.
Calcutta Airport, B. L. BOSE.
Dum Dum, June 12, 1953.

X-RAY DIFFRACTION AND ELECTROLYTIC DISSOCIATION

THE study of progressive dissociation of electrolytes in aqueous solutions by the method of X-ray diffraction in liquids was proposed for the first time by R. S. Krishnan¹ in his investigations on sulphuric acid and sulphates at different concentrations. From a comparative study of the X-ray diffraction patterns, he concluded that the stepwise dissociation of sulphuric acid was responsible for the observed effects. He also observed the X-ray diffraction effect in KHSO_4 solution but made no observation on the change of the degree of dissociation with concentration.

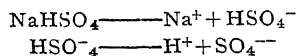
Raman effect studies² in concentrated solutions indicate that normal salts are completely dissociated at all concentrations and that in strong acids and acid salts, the degree of the dissociation increases with dilution.

X-ray diffraction pattern of aqueous solutions of NaHSO_4 at various concentrations as well as in the powder state have been investigated using the CuK_α radiation and powder photograph method. A remarkable series of photographs has been obtained which portray all the changes taking place from the solid state to a state of very dilute solution in a very vivid manner. For instance, in very concentrated solutions NaHSO_4 forms a ring of its own which is slightly greater than the water-ring and corresponds roughly to the average spacing for the powder pattern. As the dilution increases, the ring becomes smaller and broader, the edges becoming more and more diffuse. At a concentration of $N/2$, no definite halo is obtained but only a corona surrounding the central spot, the diameter of the edge of the corona corresponding roughly to the outer edge of the water-ring. With further dilution the halo reappears, the maximum of which coincides with that of water in very dilute solutions.

The diffraction patterns in concentrated solutions have been interpreted as mainly due to the rearrangement of the water molecules in the

electric field of the ions,³ these being too light to contribute appreciably to the diffraction pattern themselves. The results are fully in accord with other observations^{4,5} in solutions that the addition of the small ions in general produces greater regularity in structure and X-ray diffraction pattern resembles closely the universal pattern of a close packed liquid.⁶

The changes in the diffraction pattern with increasing dilutions have been explained on the basis of the two-stage dissociation of NaHSO_4 , viz.,



An attempt has been made to correlate the results with those obtained from Raman effect studies.

Investigations are in progress on other acids and salts, and some very interesting results have been obtained. The details will be published elsewhere.

Physics Dept.,
Lucknow University,
May 20, 1953.

P. N. SHARMA.
S. N. DUTTA.
S. R. BHATTACHARYA.

1. Krishnan, R. S., *Proc. Ind. Acad. Sci.*, 1937, **4**, 661. 2. Hibben, "The Raman Effect and Its Chemical Applications" (*American Chemical Society Monograph Series No. 80*), 1939. 3. Bernal, J. D. and Fowler, R. H., *J. Chem. Phys.*, 1933, **1**, 515. 4. Meyer, H. H., *Ann. Der. Phys.*, 1930, **5**, 701. 5. Ganesan, A. S. and Venkateswaran, S., *Ind. J. Phys.*, 1929, **4**, 195. 6. Prins, J. A., *J. Chem. Phys.* 1935, **3**, 72.

RADIOACTIVITY OF CHARNOKITES AND THEIR PETROGENESIS

THE controverted problem of the petrogenesis of charnockites has been studied by several research workers of the Geology Department of the Andhra University since 1945 in the light of their petrography and petrochemistry. An attempt is made in the course of this note to examine the problem from a new angle—the radioactivity distribution.

Twenty-two representative samples of charnockites and associated rocks, drawn from Ananthagiri, Kondapalli, Pallavaram and Trichinopoly areas, which are roughly spaced at intervals of about 200 miles, were examined for their radioactivity. The consolidated data is presented in the following table in the order of decreasing radioactivity (in terms of equivalent uranium content in grams of U per gram of rock).

When this data is studied in conjunction with relevant geological information, it is found that the radioactive content of a rock suite of a

particular area is intimately related to the petrogenetic history.

| | Average radio-activity of charnockites | Highest radio-activity associated with acid charnockites | Highest radio-activity associated with leptynites |
|---|----------------------------------------|----------------------------------------------------------|---------------------------------------------------|
| A | 17.654×10^{-6} | 37.27×10^{-6} | Not determined |
| P | 12.813×10^{-6} | 36.78×10^{-6} | 22.77×10^{-6} |
| T | 8.523×10^{-6} | 25.68×10^{-6} | 12.84×10^{-6} |
| K | 6.002×10^{-6} | 10.75×10^{-6} | 7.60×10^{-6} |

A—Ananthagiri area, Visakhapatnam District ; P—Pallavaram area, Madras ; T—Trichinopoly area ; K—Kondapalli area, Krishna District.

In the Ananthagiri area, the manifestations of the processes of granitisation are clearly discernible.⁴ Felspathisation, which may be taken as a particular case of granitization, appears to have markedly influenced the mineralogical constitution of the rocks of this area. That these processes had been all-pervasive is borne out by the relatively higher content of micas and amphiboles even in the basic rocks, which suggests that their normal constitution has been modified to some extent by the later hyperfusible constituents. The granitic ichor, rich in radioactive constituents, slowly rises into the superposed rocks and diffuses the radioactive material into the surrounding zones.³ According to Bugge,² the radioactive elements are often mobilized in remelting and migrate in the ichor, which is capable of moving to distances ranging from a few millimetres to several kilometres. The petrogenetic history of the Ananthagiri charnockites is thus reflected in the high radioactivity associated with them, both individually and collectively.

At Kondapalli, the basic and ultrabasic varieties of charnockites form a sizable proportion of the total charnockitic rocks.^{7,8,9} The association of chromite, as well as the mineralogical and chemical composition of the basic and ultrabasic varieties are clearly suggestive of their predominantly igneous origin, as differentiation products of a basic magma. The magma, which had given rise to these rocks, appears to have been poor in hyperfusible constituents to start with, as is suggested by the low radioactivity of even the acid charnockites of this area. It is, therefore, not surprising that a group of rocks with such a petrogenetic history as Kondapalli charnockites should be characterized by low radioactivity.

The chief interest of Pallavaram^{1,5,6} and Trichinopoly groups of charnockites lies in the fact that they show evidence of both magmatic

differentiation and granitization. In keeping with this field evidence, their radioactivity is intermediate between the Ananthagiri and Kondapalli groups of charnockites. The radioactivity of Leptynites shows the same alignment as exhibited by charnockites and thus constitutes additional evidence to support the surmises made earlier.

From these observations, it appears that the study of the radioactivity of charnockites gives a valuable clue to its genetic history and that a charnockitic group with low radioactive content may be indicative of the possibilities of occurrence of economic minerals like chromite.

A detailed paper with full data and technical information is being published by one of us (U. A. N.).

This work was carried out under the ægis of the Council of Scientific and Industrial Research Scheme in progress in the Geology Department.

Geology Dept., C. MAHADEVAN.
Andhra University, U. ASWATHANARAYANA.
Waltair, May 28, 1953.

1. Bhaskara Rao, A., *M.Sc. Thesis, Andhra Univ.*, 1950. 2. Bugge, A. W., *Avhandl. Norske Videnskaps, Akad. Oslo I Mat. Natur. Klasse*, 1945, No. 13. 3. Eskola, P., *Mineralog. u. Petrog. Mitt.*, 1932, 42, 455. 4. Kukkuteswara Rao, B., *M.Sc. Thesis, Andhra Univ.*, 1951. 5. Rajagopalan, C., *Proc. Ind. Acad. Sci.*, 1946, 24, 315. 6. —, *Ibid.*, 1947, 26, 237. 7. Srirama Rao, M., *Ibid.*, 1946, 24, 199. 8. —, *Ibid.*, 1947, 26, 133. 9. Venkatappayya, N., *M.Sc. Thesis, Andhra Univ.*, 1947.

ON THE ROLE OF IRON IN STREPTOMYCIN FORMATION BY *S. GRISEUS**

In previous communications^{1,2} the high streptomycin production by *S. griseus* when grown in an aqueous extract of wheat bran was shown to be due to its mineral content. The results of further experiments on various elements present in the bran extract ash are presented below.

The proximate analysis of the bran extract ash showed it to contain the following elements: K, Ca, Mg, Al, Na, Fe, Cu and Mn. To get a qualitative idea regarding the role of elements on streptomycin production, the following procedure was adopted. To a basal medium in which streptomycin production was negligible the various elements were added, the addition being made such that the effect, if any, of each element could be easily made out. The experimental methods for culturing the organism for estimating the streptomycin titre, etc., were the same as those previously described.³ The re-

sults of these studies are presented in Table I. Cu has been added in the form of CuSO_4 , 5 H_2O , Mg as MgSO_4 , 7 H_2O , Fe as FeCl_3 , 6 H_2O and Al as alum.

TABLE I

| Composition of medium | Streptomycin titre | Days after inoculation |
|------------------------------------------------|--------------------|------------------------|
| 1 Basal medium (B.M.) | 20 | .. |
| 2 B.M. + Cu 0.26 | 15 | .. |
| 3 B.M. + Cu 0.26 + Mg 5.0 | 15 | .. |
| 4 B.M. + Cu 0.26 + Fe 0.06 | 72 | 7, 8 |
| 5 B.M. + Fe 0.06 + Al 3.0 | 72 | 7, 8 |
| 6 B.M. + Fe 0.06 + Cu 0.26 + Al 3.0 + NaCl 1.5 | 92 | 7, 8 |

* Quantities mentioned in column 1 are in mg. per 100 ml. of B.M.

It is clear from the table that of the elements added, only iron has marked influence on the streptomycin production. The effect observed on adding sodium chloride had been reported earlier.¹

The effect of varying amounts of iron on streptomycin was next investigated. Different amounts of iron were added to basal medium and antibiotic production studied. The results are presented in Table II.

TABLE II

| Amount of Fe in mg./100 ml. | Maximum streptomycin titre | Day after inoculation |
|-----------------------------|----------------------------|-----------------------|
| Nil | 15 | .. |
| 0.125 | 68 | 8, 9 |
| 0.250 | 75 | 8 |
| 0.500 | 93 | 0 |
| 0.600 | 98 | 8 |
| 0.700 | 108 | 8 |
| 1.000 | 110 | 8 |

The remarkable effect of small quantities of iron on streptomycin formation is obvious, about 0.7 mg. per 100 ml. of the basal medium being optimum.

Iron, therefore, appears to be the element present in bran extract ash which stimulates streptomycin production by *S. griseus*.

The author is indebted to Dr. V. Subrahmanyan for his interest, and the C.S.I.R. for financial support.

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MICRO-ELECTROPHORETIC STUDY OF SERUM PROTEINS FROM NORMAL AND MALARIAL CHICKEN

(INFECTED WITH *PLASMODIUM
GALLINACEUM*)

THE determination of the proteins in the blood serum by electrophoresis has attained great importance¹ and electrophoretic studies of chicken serum proteins under diverse conditions have been reported in the literature.²⁻⁶ Work has been carried out in these laboratories by one of the authors (R. R.) to find out the protein levels by salt fractionation technique⁷ in normal and malarial chicken. The electrophoretic investigation was undertaken to confirm and extend the above study and to elucidate the presence of new components, if any.

Chicken of the white leghorn breed from 12-15 weeks of age were used for the experiment. They were kept in individual cages and fed with the laboratory standard diet. Birds were usually made to fast 24 hours previous to taking blood. Blood was taken from individual birds by cardiac puncture and allowed to clot. Serum was obtained by mild centrifugation. After getting the normal serum the same birds were injected intramuscularly with 16×10^6 parasites. Blood from parasitised birds was taken and serum was prepared. Each sample of the serum obtained was generally diluted with four times its volume with Michaelis buffer⁸ (pH 8.6, ionic strength 0.1). The diluted serum was dialysed for a period of 40-70 hours against 250 ml. of buffer using cellophane bags. The electrophoresis was carried out in Kern's micro-electrophoresis apparatus⁹ at the room temperature ($25^\circ \pm 2^\circ \text{C.}$). Field strengths of 4-6 volts per cm. were employed and the fractionation was over within 60 minutes. The ascending and the descending interferometric electrophoresis patterns of normal and malarial serum are given in Figs. 1 and 2.

Calculations were made from the descending patterns after plotting the curves as given by Lebhards.¹⁰ The relative composition of the various fractions has been calculated from the curves obtained. The mobilities have been determined from the mean position moved by each fraction.¹¹ The initial and final temperatures in the open limb of the buffer were read and conductivities were calculated at the average temperature by applying 2 per cent. correction for each degree rise in temperature. The results of this investigation are presented in Table I.

TABLE I
Mobility* and relative composition of chicken serum proteins under normal and pathological conditions

| Fraction | Normal | | Normal (Sanders) ⁶ | | Malarial (average 43% parasites) | |
|------------|--------------------------------|----------------------------------|--------------------------------|---------------------------------|----------------------------------|----------------------------------|
| | Average percentage composition | Mobility at 25°C. | Average percentage composition | Mobility at 0°C. | Average percentage composition | Mobility at 25°C. |
| Albumin | 59.3 | 14.7 | 57.9 | 5.7 | 40.5 | 14.5 |
| α_1 | .. | 4.5 | 12.64 | .. | 6.0 | 12.2 |
| α_2 | .. | 9.0 | 10.0 | 4.5 | 11.1 | 9.5 |
| β | .. | 13.0 | 6.1 | 9.3 | 14.6 | 5.9 |
| γ | .. | 14.3 | 2.2 | 17.2 | 1.9 | 28.0 |

* Mobilities are given in $\times 10^{-5} \text{ cm.}^2 \text{ volt}^{-1} \text{ sec.}^{-1}$

From the results presented in the above table, it is clear that there is a marked change in the total protein as well as in the albumin and γ -globulin fractions in serum proteins of the chick having a very acute malarial infection. The average value of the total protein concentration has decreased from 3.97 g./100 ml. to 2.61 g./100 ml.

It is further clear from the above pattern that there is no formation of a new component

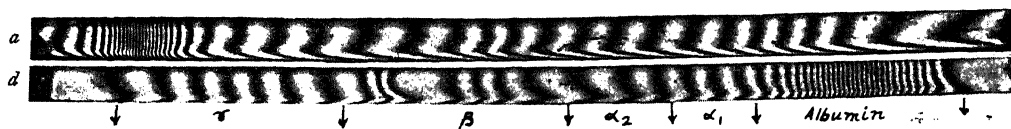


FIG. 1

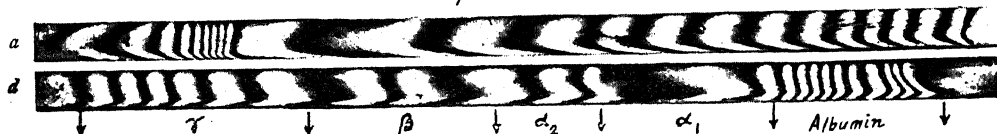


FIG. 2

FIG. 1.—A typical interferometric electrophoretic pattern of normal chick serum protein in Michaelis buffer, $\mu=0.1$, pH=8.6. Dilution 1 : 3. Experiment carried out for 50 minutes under 64.0 volts \times 4.2 milliamperes. *a*: ascending pattern, *d*: descending pattern.

FIG. 2.—A typical interferometric electrophoretic pattern of malarial chick serum protein under the above experimental conditions. Dilution 1 : 4. Experiment carried out for 60 minutes under 55 volts, \times 3.75 milliamperes. *a*: ascending pattern, *d*: descending pattern.

in the serum from the malarial chick. The decrease in the albumin moiety as well as the increase in globulins is due to the liver and kidney damage. The increase in the γ -globulin content may be due to the probable immunological response of the chick on account of infection. Besides these, there are no other marked changes in α_1 , α_2 and β -globulins. The mobilities of the various components did not show any major changes in the pathological condition. Our findings are in agreement with the general nature of changes in serum protein concentration (salt precipitation technique) reported by others^{12,13} in malarial infections met with in man and monkeys.

Since malarial parasite is an intracellular organism it is expected that a study of the red cell protein¹⁴ in the normal and pathological condition along with the present study will give us a complete picture of the changes likely to occur in whole blood. This study is in progress and will be reported in future communication.

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ESTIMATION OF PHOSPHORUS IN SOILS BY COLORIMETRY

VARIOUS analysts have been working on the application of colorimetry for the determination of phosphoric acid in soils employing the molybdenum blue colour obtained by reduction.¹⁻⁴

The soils on which coffee is grown in South India contain appreciable amounts of iron which

interfere in the development of the molybdenum blue colour. For such soils, the following modification of the Sherman method has proved successful.

The soil samples (usually 5 g. air-dry sample) are digested as per Piper's⁵ method with (50 ml.) constant B.P. hydrochloric acid for one hour, cooled and made up to a known volume (200 ml.). A suitable aliquot depending on the P_2O_5 content of the soil (usually 2 ml.) is taken, in a 25 ml. standard volumetric flask, diluted to approximately 20 ml., 2.5 ml. of 60 per cent. perchloric acid added, followed by 0.8 ml. of 1-2-4-amino naphthol sulphonic acid reagent (0.125 g. of 1:2:4-amino naphthol sulphonic acid in 44 ml. of 15 per cent. $NaHSO_3$ and 5-7 ml. of 20 per cent. Na_2SO_3)³ and 2 ml. of a 5 per cent. solution of ammonium molybdate, made up to volume, allowed to stand for 15 minutes and the deflection read off on a colorimeter (EEL portable colorimeter) using a red filter. The P_2O_5 values are read off on a graph previously prepared in which varying quantities of standard K_2HPO_4 are plotted against the deflections observed. A practically straight line graph is obtained.

The following table gives the results obtained with a few samples of soils:—

| No | Soil sample | % Organic matter (organic carbon \times 1.724) | % P_2O_5 HCl extract (volumetric method) | % P_2O_5 (per- chloric acid extract, colorimetric) | % P_2O_5 (HCl extract, perchloric acid, colorimetric) |
|----|-----------------------|--------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Kolarkhan Soil No. A | 1.243 | 0.150 | 0.151 | 0.153 |
| 2 | " B | 1.955 | 0.175 | 0.169 | 0.161 |
| 3 | " C | 3.740 | 0.197 | 0.205 | 0.200 |
| 4 | " D | 0.084 | 0.082 | 0.082 | 0.081 |
| 5 | Emmekhan Soil No. A | 4.048 | 0.096 | 0.097 | 0.105 |
| 6 | " B | 4.119 | 0.197 | 0.178 | 0.199 |
| 7 | " C | 5.114 | 0.322 | 0.308 | 0.318 |
| 8 | " D | 2.677 | 0.110 | 0.108 | 0.106 |
| 9 | " E | 3.284 | 0.092 | 0.085 | 0.083 |
| 10 | " F | 1.782 | 0.119 | 0.109 | 0.107 |
| 11 | Kummargode soil No. A | 2.891 | 0.234 | 0.212 | 0.230 |
| 12 | " B | 3.589 | 0.147 | 0.146 | 0.144 |
| 13 | " C | 3.911 | 0.173 | 0.171 | 0.171 |
| 14 | " D | 3.693 | 0.111 | 0.092 | 0.106 |
| 15 | " E | 3.315 | 0.176 | 0.176 | 0.167 |

It will be seen from the above that good agreement can be obtained using the colorimetric method for soils with a wide range of organic matter content.

It is possible to use the usual hydrochloric acid extract for determining the P_2O_5 content

of soils by adding 2.5 ml. of 60 per cent. perchloric acid for a final volume of 25 ml. at time of developing of colour with 1-2-4 amino naphthol sulphonic acid and ammonium molybdate. The HCl extract can be used for determining K_2O , etc., thus saving on time and expenditure.

When using an HCl extract with added perchloric acid, the colour developed is constant up to 45 minutes after which the intensity increases. Also there is no effect of chloride ions up to a concentration of HCl which is $2\frac{1}{2}$ times the concentration present in a usual HCl extract of soils at the time of development of colour.

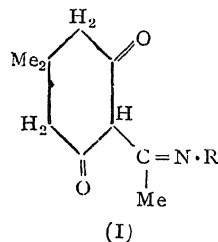
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CONDENSATION OF C-ACETYL-METHONE WITH PRIMARY AMINES

DIECKMANN and STEIN¹ have described an "anilide" of C-acetylmethone. The same anilide as well as "p-toluidide" and "monoamine" of C-acetylmethone have been prepared by Crossley and Renouf.² These derivatives were prepared by these authors during a study of C-acetylmethone and were not studied in much detail and the problem of their constitution was not tackled. It has, therefore, been considered worthwhile to study the reaction of C-acetylmethone with primary amines (aromatic and heterocyclic) in detail and to attempt to determine the constitution of the condensation products. With this end in view, C-acetylmethone has been condensed with aniline, p-chloro-, p-bromo, and p-iodoanilines, o- and m-toluidines, o- and p-xylylides, α - and β -naphthylamines, sulphanilamide, benzidine and 2-amino thiazole.

The condensation products have been characterized as 5, 5-dimethyl-2-(α -arylimino-) ethylcyclohexane-1, 3-diones of the general formula (I).



The melting points and the physical appearance of the condensation products are tabulated below:

| R | m.p. (uncorrected) | Physical Appearance |
|------------------------|-----------------------|------------------------------------|
| Phenyl- | 132° -2.5° | Colourless long flat needles |
| p-Chlorophenyl- | 156.5°-7.5° | Colourless long prismatic needles |
| p-Bromophenyl- | 158.5°-9.5° | Colourless long prismatic needles |
| p-Iodophenyl- | 150° -1° | Colourless prisms |
| o-Tolyl- | 123° -4° | Colourless prismatic needles |
| m-Tolyl- | 117° -7.5° | Colourless long rectangular plates |
| o-Xylyl- | 118° -8.5° | Colourless clusters of stout prism |
| p-Xylyl- | 155.5°-6.5° | Colourless clusters of plates |
| α -Naphthyl- | 165° | Colourless glistening plates |
| β -Naphthyl- | 184° -5° | Colourless glistening plates |
| p-Sulphonamido-phenyl- | 247° -9° | Colourless long rectangular plates |
| 2-Aminothiazolyl- | 202° (dec.) | Dark brown solid |

Two molecules of C-acetylmethone condensed with one molecule of benzidine to give a crystalline product, m.p. 290°-2°.

The condensation products yielded bis-2:4-dinitrophenylhydrazones which did not melt up to 340°.

Full details about this work and investigations about the structure of the condensation products will be reported elsewhere.

Our thanks are due to Dr. Sukh Dev for his helpful suggestions during the course of this work.

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VITAMIN A AND ESSENTIAL FATTY
ACIDS IN THE PRODUCTION OF
CUTANEOUS LESIONS IN RATS

'PHRYNODERMA'—a follicular hyperkeratosis of the skin, is a common manifestation of a deficiency disease prevalent in India. This skin condition has been described occurring in association with xerophthalmia and keratomalacia by Frazier and Hu¹ in China, Loewenthal⁴ in East Africa, Nicholls⁷ in Ceylon, Radhakrishna Rao¹⁰ in India, Pemberton⁹ in England, Lehman and Rapaport³ in America and Pallister⁸ in Malaya. For over a decade, these lesions have been interpreted as pathognomic of vitamin A deficiency, but recent work of Gopalan² and Menon⁵ *et al.* stress the importance of certain members of vitamin B complex and essential fatty acids.

A review of the literature on the cutaneous manifestations in vitamin deficiency reveals the fact that although in several of the human deficiency syndromes skin lesions are prominent, it is not always clear, however, which nutrient is responsible for the observed changes. Recently, Moul⁶ has revealed that keratotic plugs may readily be induced in rats maintained on a vitamin A-free diet and that these plugs are identical with those occurring in human subjects.

The aim of the present investigation was to elucidate the comparative functions of vitamin A and essential fatty acids in maintaining the epi-

thelium of the rat in a normal state and to study the effects of deficiencies of these factors on the structure of the skin.

In the first experiment, albino rats (Haffkine inbred strain) were maintained on diets, the vitamin A content of which ranged from 0-50 I.U. The synthetic diets supplemented with 0-5 I.U. of vitamin A when given to animals, produced hyperkeratinization of the outermost layer of the skin (stratum corneum), together with dilatation and plugging of the hair follicles. The degree of hyperkeratinization and plugging were inversely proportional to the amount of vitamin A in diet.

The second experiment was conducted to study the effect of various fats containing different proportions of essential fatty acids. The animals were maintained on fat-free diet and diets containing various types of fats—vegetable, animal and hydrogenated, supplying different percentages of essential fatty acids. The cutaneous lesions in this experiment, where the fat was deficient in essential fatty acids, resembled very closely those occurring in the previous vitamin A-deficient experiment. However, the following differences have been observed. Vitamin A deficiency was characterized by hyperkeratinization in which keratin material appeared to be deposited in loose lamellæ. In late stages, atrophy of the lining epithelium of the hair follicles as well as the sebaceous glands, was evident. The

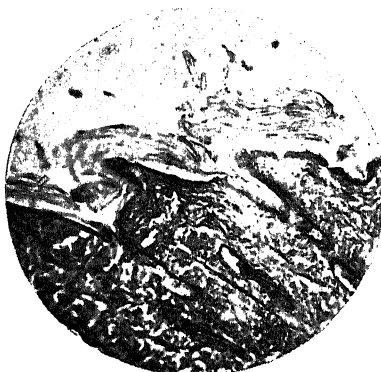


FIG. 1



FIG. 2

FIG. 1. Skin section of a rat on a completely vitamin-A deficient diet, showing marked hyperkeratosis of the hair follicles, dilatation of their funnels by keratotic plugs and atrophy of the lining epithelium of the hair follicles and sebaceous glands. Keratin is present in loose lamellæ.

FIG. 2. Skin section of a rat on a fat-free diet showing marked hyperkeratosis of the hair follicle, dilatation of their funnels by keratotic plugs. The lining epithelium of the hair follicles and sebaceous glands do not show atrophic changes. Keratin is denser than in the case of vitamin A deficiency.

(Figs. 1 and 2—Ehrlich's acid hæmatoxylin and eosin stain, $\times 65$).

essential fatty acid deficiency was characterized by hyperkeratinization wherein the keratinous material was deposited in dense masses. The epithelial lining of the hair follicles and the sebaceous glands were not effected even in extreme cases.

Finally, a third conclusive experiment was carried out by giving a mixture of hydrogenated oil and gingelly oil (a rich source of essential fatty acids), as the source of the fat in the diet. By replacing a part of hydrogenated fat by gingelly oil in the diet, it was shown that lesions are completely prevented. Thus, indirect evidence in support of the fact that the essential fatty acid content of the oil is responsible for maintaining the skin in a healthy condition has been obtained.

It is concluded that deficiencies of vitamin A in conjunction with essential fatty acids play an important role in the production of cutaneous lesions in rats resembling those in 'phrynoderma'. It is suggested that 'phrynoderma' may be due to the combined deficiencies of both these factors. The experimental evidence further points out that lack of vitamin A plays a larger role in the production of cutaneous lesions resembling 'phrynoderma'.

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CARBOHYDRATES OF GARLIC (*ALLIUM SATIVUM* L.) AND ONION (*A. CEPA* L.)

In extending our investigations on minor food materials, the aid of paper chromatography was sought for a preliminary screening in determining the choice of a material for nutritional studies. Thus, the qualitative make-up of

water-soluble carbohydrates in the bulbs of garlic and onion was determined (Fig. 1). It was found to be similar to what has been already reported by us for *Agave vera cruz*.¹

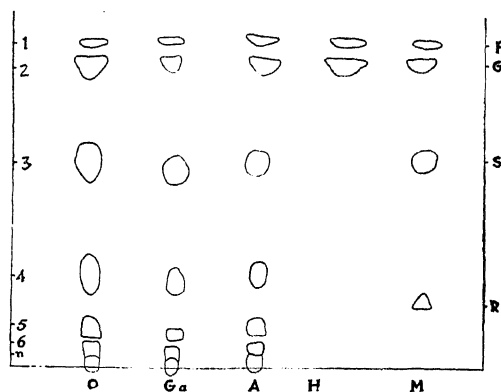


FIG. 1. Chromatogram of the carbohydrates of onion and garlic.

Onion juice (O), Garlic juice (Ga), Agave juice (A; for comparison): hydrolysates of the three (H: all three gave only glucose and fructose): reference sugars (M: mixture of fructose, glucose, sucrose and raffinose. corresponding separated spots, marked F, G, S and R): Developed in butanol-acetic acid-water (4:1:5) for 6 days (ascending). Sprayed with benzidine-trichloroacetic acid reagent. (Guide strips of O, Ga sprayed with phloroglucinol-trichloroacetic reagent showed the presence of easily hydrolysable ketose residues in the carbohydrates corresponding to spots 4 to 6; cf. refce. 1).

The presence of fructosan type of carbohydrates in *Allium* is known,² but they do not appear to have been precisely characterised. This aspect is being studied. Fructose, glucose and sucrose detected among the sugars, being normal, need no comment, except perhaps in relation to the ultimate polyfructosan synthesis. What deserves emphasis here, is the pattern of carbohydrate make-up, especially those corresponding to spots 4, 5 and 6. The fact that this uniform, though at the moment qualitatively determined pattern recurs with the carbohydrates derived from such widely differing sources as the tubers of Jerusalem artichoke (*Compositae*),³ the stem of *Agave vera cruz* (*Amariyllidaceae*)¹ or the bulbs of *Allium* (*Liliaceae*), all of which are free from starches—seems to be significant for the understanding of the synthesis of polyfructosans, the status of which as a reserve plant food is now fairly well established.⁴

We wish to thank Dr. Girdhari Lal for his keen interest in the work.

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PAPER CHROMATOGRAPHIC SEPARATION OF B-GROUP VITAMINS

Most of the B-group vitamins have been individually studied by paper chromatographic technique and their separations from their derivatives or similarly related substances were achieved by various workers using different solvents.¹⁻⁶ Brown and Marsh⁷ separated the

vitamins in a mixture of thiamine, riboflavin, nicotinamide and pyridoxine hydrochloride by running a single paper chromatogram and identified the vitamins spectroscopically by means of automatic scanning device. In this laboratory, most of the B-group vitamins, viz., thiamin hydrochloride, riboflavin, choline chloride, inositol, nicotinic acid, nicotinamide, B₁₂, calcium pantothenate, biotin, pyridoxine hydrochloride and *para*-aminobenzoic acid were successfully separated and identified from a mixture containing all these vitamins by ascending paper chromatography. The paper containing the spots of the mixture of vitamins was irrigated with the non-aqueous phase of a mixture of 2 volumes of *n*-butanol, 1 volume each of methyl alcohol, benzene and water. In a period of 4½ hours, the solvent front traversed a distance of about 18 cm. parallel to the filter-paper fibre and a fairly good separation was achieved. All the vitamins were identified by applying in most cases specific chemical tests. However, in the case of biotin, the use of a specific reagent, tetranitromethane was not found suitable because the minimum amount of the vitamin required for identification was 150 µg. Dilute acidified potassium permanganate solution, on the other hand, gave a yellow spot of biotin sulfone¹¹ even when 4 µg. of

TABLE I

| No. | Vitamin | Identification | Colour of the spot | Mean R _f value† | Minimum concentration required for identification (µg.) |
|-----|---------------------------------|----------------------------------------------------------------------------------|--------------------|----------------------------|---------------------------------------------------------|
| 1 | Inositol | .. Ammoniacal silver nitrate (4) | Brownish black | 0.14 | 5.0 |
| 2 | Vitamin B ₁₂ | .. Light pink spot | Light pink | 0.25 | 1.5 |
| 3 | Choline chloride | .. Iodine vapour (8) | Reddish brown | 0.34 & 0.44* | 3.0 |
| 4 | Calcium pantothenate | .. Ammonium salt of β-napthaquinone-4-sulphonic acid after alkali treatment (9) | Violet | 0.36 | 80.0 |
| 5 | Riboflavin | .. Yellow spot and yellowish-green fluorescence in ultra-violet | Yellow | 0.40 | 0.8 |
| 6 | Nicotinic acid | .. Exposed to CNBr vapour and sprayed with benzidine in 1 : 1 ethanol-water (10) | Violet | 0.44 | 0.5 |
| 7 | Nicotinamide | .. " " " " | Violet | 0.73 | 2.0 |
| 8 | Thiamine hydrochloride | .. Fluorescence of thiochrome in ultra-violet | Blue | 0.47 | 4.0 |
| 9 | Biotin | .. Dilute acidified potassium permanganate solution | Yellow | 0.64 | 4.0 |
| | | Tetranitromethane | Yellow | 0.64 | 150.0 |
| 10 | Pyridoxine hydrochloride | .. Dilute acidified potassium permanganate solution | Yellow | 0.73 | 1.5 |
| 11 | <i>Para</i> -amino benzoic acid | .. <i>Para</i> -dimethylamino benzaldehyde in glacial acetic acid | Yellow | 0.80 | 0.5 |

* Choline was found to give two spots when thiamine was also present in the mixture.

† Ascending paper chromatography.

biotin was present. Either of these tests may be satisfactorily employed depending on the concentration of the vitamin in the mixture. The average R_f values obtained in about 50 runs under laboratory conditions, the minimum concentration of the vitamin required for identification and the tests applied in brief are given in Table I. This method was successfully employed for identifying the various constituents in commercial vitamin tablets and further extended by employing circular paper chromatography. A detailed account of the work will be published elsewhere.

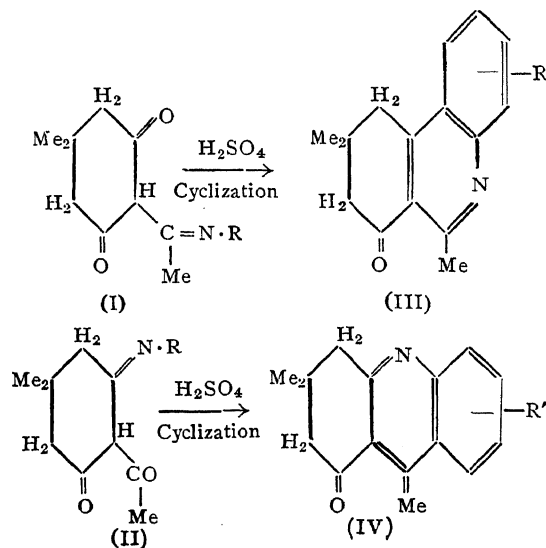
R. RADHAKRISHNAMURTY.

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CYCLIZATION OF THE IMINES OF C-ACETYLMETHONE: FORMATION OF PHENANTHRIDINES

The products of condensation of C-acetylmethone with primary amines¹ can be represented by either of the two formulæ, (I) and (II). Evidence in favour of the formula (I) is presented in this note.



where R = phenyl or substituted phenyl radical, and R' = substituent(s) on the benzene ring.

On cyclization, compounds having structure (I) would lead to the formation of phenanthridine derivatives (III) while compounds of structure (II) would yield acridine derivatives (IV). In the present study, the condensation products (imines) of C-acetylmethone with aniline, *p*-chloro- and *p*-bromo- anilines, *o*- and *m*-toluidines, and *o*- and *p*-xylydines have been cyclized by heating them with concentrated sulphuric acid on a water-bath. The cyclized products have been characterized as phenanthridine derivatives (III). The melting points of these phenanthridines and their derivatives are recorded in the table below.

The cyclized product from aniline (1) was studied in detail as a typical member of the series. It was oxidized with dilute nitric acid, when 2-methyl-quinoline-3, 4-dicarboxylic acid was obtained. The acid was characterized by analysis and comparison with an authentic sample.

| No. | Name of the compound | M.P. (uncorrected) |
|-----|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| 1 | 7-Oxo-7, 8, 9, 10-tetrahydro-6, 9, 9-trimethyl-phenanthridine Picrate Hydrochloride 2:4 Dinitrophenylhydrazine | 99° -9.5° .. 219° -20° (dec.) .. 237° -8° 278° (dec.) |
| 2 | 2-Chloro-7-oxo-7, 8, 9, 10-tetrahydro-6, 9, 9-trimethyl-phenanthridine Picrate | 130.5° .. 221° (dec.) |
| 3 | 2-Bromo-7-oxo-7, 8, 9, 10-tetrahydro-6, 9, 9-trimethyl-phenanthridine Picrate | 137° -8° .. 224° (dec.) |
| 4 | 7-Oxo 7, 8, 9, 10-tetrahydro 4, 6, 9, 9-tetramethyl-phenanthridine Picrate Hydrochloride 2:4-Dinitrophenyl hydrazone | 105° -6° .. 169.5°-70.5° .. 162° -3° 335° |
| 5 | 7-Oxo-7, 8, 9, 10-tetrahydro-3, 6, 9, 9-tetramethyl-phenanthridine Picrate Hydrochloride | 186° -7° (dec.) .. 250° -1° |
| 6 | 7-Oxo-3, 4, 6, 9, 9-pentamethyl-7, 8, 9, 10-tetrahydro-phenanthridine Picrate Hydrochloride 2:4-Dinitrophenyl hydrazone | 125° .. 158° -9° .. 200° -2° 284° (dec.) |
| 7 | 7-Oxo-1, 4, 6, 9, 9-pentamethyl-7, 8, 9, 10-tetrahydrophenanthridine Picrate | 122° -3° .. 139.5°-40.5° |

Full details will be published elsewhere.

Our thanks are due to Dr. Sukh Dev for his kind interest in this work.

Dept. of Organic Chemistry, G. M. CHOPRA.
Indian Institute of Science, B. H. IYER.
Bangalore-3, April 25, 1953.

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A METHOD FOR THE ISOLATION OF INDIVIDUAL DENDRITIC CELL FROM HUMAN AND GUINEA-PIG SKIN

IN connection with a research project pertaining to the relationship of the chromatophorotropic hormone of the pituitary gland with the pigmentation of the skin,¹⁻³ it was necessary to devise a technique for the study of the mechanism of pigment formation in the dendritic cells of the basal layer of the skin. These cells are credited with the power of synthesis of melanin pigment. After repeated failures, the following method was evolved which gave fairly satisfactory results in our hands. A preliminary note is published in order to help workers in this field. Detailed description with relevant data pertaining to the mechanism of melanogenesis will be published elsewhere in due course.

Epidermis was separated from dermis according to the method of Medawar.⁴ The method of Billingham⁵ was then followed to isolate the dendritic cells. It was, however, found that if the method of fixation for half-an-hour in formol-calcium (Baker⁶) as recommended by Billingham is followed, the dendritic processes become so cemented with the matrix that subsequent separation becomes difficult. After many trials, we found that this fixation should be permitted to operate for only two minutes instead of half-an-hour. A modification was further necessary in the Dopa treatment of the epidermis in that a saline solution in phosphate buffers had to be used in place of aqueous solution and the pH had to be controlled and kept at 7.8 for one hour. This quick treatment prevented damage to the dendritic cells. After the Dopa reaction is over, as indicated by sepia tone of the solution, the pure epidermis piece was mounted in a drop of 15 per cent. aqueous glycerine with the dermal side of the epidermis above, and this was gently dabbed with a camel hair brush. The skin specimen was then removed and the glycerine solution left on the slide is covered by a cover glass and sealed by 'Cutex'. The dendritic cells come off from the epidermis and remain on the slide. The glycerine prevents dehydration and permits the cell to remain in a more or less natural free state.

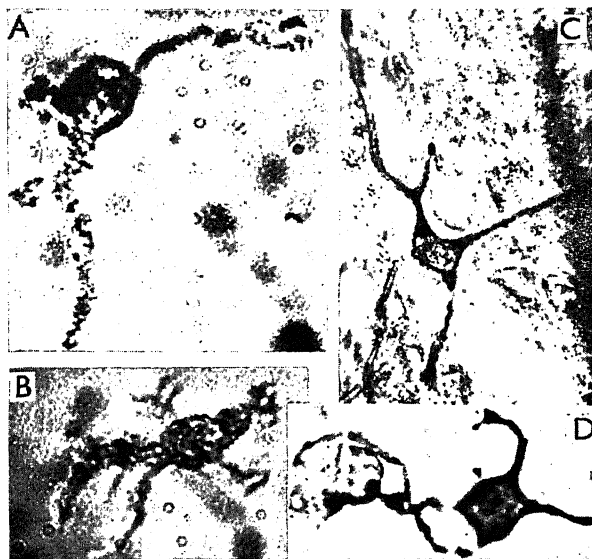


FIG. A & B. Isolated d. c. of human skin ($\times 530$).
FIGS. C & D. Isolated d. c. of guinea-pig skin ($\times 400$).

Photomicrographs A and B (see plate) show the isolated d.c. from the peroneal surface of the leg of human beings and photomicrographs C and D refer to the isolated d.c. from the black part of the back and ear of the spotted guinea-pig.

Central Drug Res. Inst.,
Lucknow,
June 8, 1953.

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J. N. KARKUN.
B. MUKERJI.

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ROLE OF BIOTIN IN THE CONVERSION OF TRYPTOPHANE TO NICOTINIC ACID

THE formation of nicotinic acid from tryptophane, first demonstrated with rats by Krehl, Sarma and Elvehjem¹ was also subsequently shown to take place in the case of other mammals,^{2,3,4} the fungus *Neurospora crassa*⁵ and plants.⁶ Further studies have been carried out by different workers to find out the various factors which affect the conversion of tryptophane to nicotinic acid. It was shown that some of the vitamins of the B group like pyridoxine and riboflavin⁷ thiamine and folic acid⁸ were found to influence this conversion.

However, the role of biotin in the breakdown of tryptophane to nicotinic acid has not been studied hitherto, and in this note the influence of biotin on the formation of nicotinic acid from tryptophane has been demonstrated for the first time. This has been achieved by the use of antimetabolite of biotin, γ , 3:4-ureylene cyclohexyl butyric acid in studies on *Neurospora crassa* (Strain 39401) and germinated greengram (*Phaseolus mungo*).

The basal medium used in the case of *Neurospora crassa* was that of Horowitz and Beadle.⁹ The organism was allowed to grow in 50 ml. conical flasks, the total volume of the media being 10 ml. containing the following substances in the basal medium in mg., ammonium tartrate 25; NH_4NO_3 : 10; K_2HPO_4 : 10; MgSO_4 : 5; NaCl and CaCl_2 : 0.1 (each); dextrose 200 and the following trace elements in gamma B: 10; Mo: 2.0; Fe: 2.0 and Zn: 20. The pH of the medium was 5.6. After 72 hours' growth at 30° C., the mycelia were carefully removed, washed, dried at 105° C., and the dried mycelia were weighed in a Roller Smith torsion balance. The total nicotinic acid in the media and mycelia was found out according to the method of Shanmuga Sundaram, Ranganathan and Sarma.⁶ The results are presented in Table I. From the weight of the mycelia and the total nicotinic acid present, it can be seen that the anti-vitamin of biotin,— γ , 3:4-ureylene cyclohexyl butyric acid exerts a deleterious effect which was overcome by the addition of excess biotin.

TABLE I

| No. | Substances added to the medium | Total nicotinic acid (mycelium + medium) in gamma | Mat weight in mg. |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------|
| 1 | 200 γ L tryptophane in 5 ml. basal medium (D.C.) + 5 ml. water (control) | 6.70 | 17.2 |
| 2 | 200 γ L tryptophane in 5 ml. basal medium (D.C.) + 2.0 mg. ureylene compound in 2.0 ml. water + 3.0 ml. water | 2.05 | 5.5 |
| 3 | 200 γ L tryptophane in 5 ml. basal medium (D.C.) + 2.0 mg. ureylene compound in 2.0 ml. water + 3 γ biotin in 3.0 ml. water | 8.50 | 18.4 |
| 4 | 200 γ L tryptophane in 5 ml. basal medium (D.C.) + 3.0 mg. ureylene compound in 3 ml. water + 2 ml. water | 1.90 | 4.0 |
| 5 | 200 γ L tryptophane in 5 ml. basal medium (D.C.) + 3.0 mg. ureylene compound in 3.0 ml. water + 5 γ biotin in 2 ml. water | 8.60 | 16.8 |

D.C.—Double concentration.

A similar observation of the inhibition in the synthesis of nicotinic acid by γ , 3:4-ureylene cyclohexyl butyric acid is noticed in the case of germinating greengram. The results are presented in Table II. Though the inhibitory effect of the antimetabolite was not as striking as that with *Neurospora crassa*, the decrease in nicotinic acid content is significant and the reversal by biotin indicates the importance of this vitamin in the conversion of tryptophane to nicotinic acid. The germination of the seeds and the estimation of nicotinic acid were done according to the method of Shanmuga Sundaram, et al.⁶

TABLE II

Nicotinic acid expressed in γ /g.
Nicotinic acid in dry seed 14.0 γ /g.

| Dish No. | Substances used in the medium | Hours of germination | |
|----------|------------------------------------------------------------------------------------------------|----------------------|---------|
| | | 48 hrs. | 72 hrs. |
| 1 | 25.0 ml. water (control) | 28.8 | 33.5 |
| 2 | 24.0 ml. water + 1 mg. ureylene compound in 1.0 ml. water | 22.9 | 27.7 |
| 3 | 23.0 ml. water + 1 mg. ureylene compound in 1.0 ml. water + 1 γ biotin in 1.0 ml. water | 26.5 | 31.8 |

Further work on the utilisation of other metabolites of tryptophane in presence of γ , 3:4-ureylene cyclohexyl butyric acid by *Neurospora crassa* (39401), and the site of action of biotin in the conversion of tryptophane to nicotinic acid is in progress and will be published elsewhere.

Our thanks are due to Dr. H. K. Mitchell, of California Institute of Technology, for the generous gift of *Neurospora* mutants and Dr. Richard O. Roblin (Jr.), of the American Cyanamid Co. (U.S.A.), for γ , 3:4-ureylene cyclohexyl butyric acid used in this investigation.

E. R. B. SHANMUGA SUNDARAM.
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Univ. Biochem. Res. Lab.,
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VASCULAR DIFFERENTIATION IN THE RADICLE OF MUSTARD

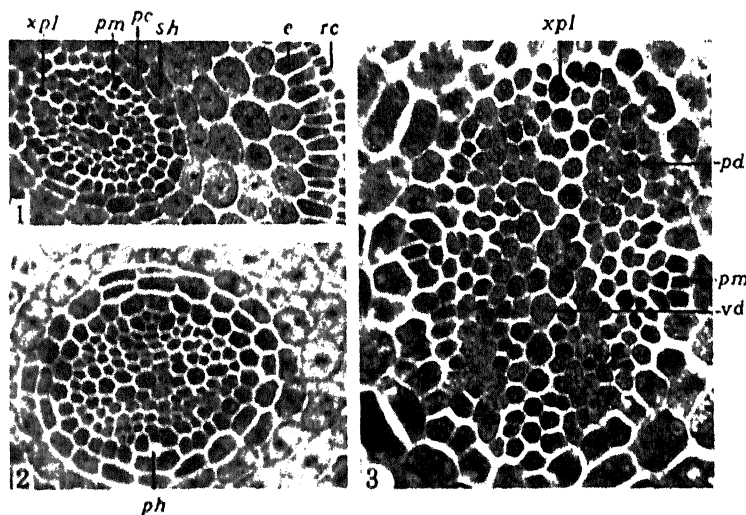
The present anatomical study of the radicle of mustard (*Brassica campestris* L.) deals with the various tissues that make up this organ, with special reference to the differentiation of the first phloem and xylem elements. Materials used were: (1) seeds soaked for 6 hours in water; (2) seedlings with radicles just emerging out; and (3) seedlings with radicles approximately 2 mm. in length. The technique followed was described in a previous communication.¹

Fig. 1 represents a transverse section of the radicle tip of material,¹ showing a single-layered deeply stained epidermal cells (*e*) surrounded by a layer of root-cap (*rc*) cells and the cortex composed of several rows of cells of which the ones nearer the epidermis are less tangentially elongated. In the centre lies the meristematic stele surrounded by a well differentiated starch sheath (*sh*) and the pericycle (*pc*). A median row of cells stretching from one inner side of the pericycle to the

with carrot and sugar beet has made similar observations. The groups of parenchyma on either side of the protoxylem pole (Fig. 3, *pa*) vacuolates more rapidly (than the cells of the xylem plate) and these, along with the vacuolated central cells (*va*) of the xylem plate, give a characteristic pattern to the stele (Fig. 3).

The mother-cells of the future phloem elements are placed opposite to each other in a plane at right angles to the xylem plate. Diameters of these cells is slightly smaller than those of the surrounding ones (Fig. 1, *pm*) and at higher levels they are slightly deeper stained than some of their immediate neighbours (Fig. 3, *pm*).

First vascular elements to mature (Material No. 2) belong to the phloem region and these have all the characteristics common to the protophloem sieve-tubes of angiosperms.¹ They are not accompanied with companion cells and thus resemble the root of pear.⁵ Another resemblance between these two roots lies in the fact that the protophloem elements on either



FIGS. 1-3. Transverse sections of mustard radicles. *e*, epidermis; *pa*, parenchyma; *pc*, pericycle; *ph*, differentiated phloem element; *pm*, phloem mother cell; *rc*, root cap; *sh*, starch sheath; *va*, vacuolated cells of the xylem plate; *xpl*, xylem plate.

FIG. 1. Radicle of a seed soaked for 6 hours sectioned at the distance of 263 μ from the tip, $\times 107$.

FIG. 2. Radicle of a seed that has just split, $\times 109$.

FIG. 3. Radicle of a seed soaked for 6 hours passing near the lower hypocotyl zone, $\times 223$.

other (*xpl*) is conspicuous by their size and deeper staining properties. These are the mother-cells of the future diarch xylem plate, vacuolation of the protoplasm of which begins in the middle (Fig. 3, *va*). Esau^{2,3} working

side of the xylem plate mature at different heights (Fig. 2). Up in the same radicle are found the first two proto xylem elements maturing again at different levels. One cell on either extremity of the xylem plate abutting the

pericycle shows contracted cytoplasm and deposition of secondary walls in the form of spiral thickenings.

In spite of the fact that the differentiation of the phloem elements starts earlier than those of the xylem ones, mature elements are added more rapidly at the protoxylem poles than at the protophloem ones as would be evidenced from the fact that in several No. 3 materials the second phloem element of a pole did not mature till there were 3-4 differentiated xylem elements near the first-formed ones.

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Balwant Rajput College,
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October 3, 1952.

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LIFE-HISTORY OF *PHENACOCCLUS* * *INSOLITUS*, GREEN (THE BRINJAL MEALY BUG)

THIS bug which is covered with coarse granular white waxy material, is observed congregating on the undersurface of the brinjal leaves. It is the ratoon brinjal crop and isolated remnants of the previous brinjal crop that are usually severely attacked by this bug, but even a fresh crop may not be immune from its attack. The bugs suck the sap from the shoots and leaves and the plants assume a sickly appearance. Leaves are shed after becoming yellow and mouldy and shoots get shrivelled up.

LIFE-HISTORY

Mating starts after a few minutes of the last moult and lasts for 4-5 minutes. A male can fertilize 15-20 females. After a fortnight, the females begin to excrete a loose sticky white sac in the form of waxy threads. In this loose cottony sac, they deposit their minute brown eggs. One female bug lays 2-3 such egg-sacs and each sac may consist of 100-120 eggs. Females shrink in size after egg-laying and die 3-4 days thereafter. Eggs hatch out to small greyish nymphs which very soon spread over the leaf and arrange themselves besides the veins. After 3-4 days the bugs begin to secrete through their derm pores the white mealy covering all over their body. The nymphs undergo 4 moults before they reach the adult stage.

First moult occurs after 10-15 days of emergence. All the white mealy powder is thrown off. Bugs attain straw colour. They move about

very swiftly from top to bottom of the plant and generally become attached to a fresh leaf. After fixing themselves they insert their beaks in the leaf-tissue to suck the sap and begin to secrete the white covering matter. No differentiation can be made between the male and female at this stage.

Second moulting occurs after 7-10 days. The bugs are now of straw colour. They enlarge in size and cast off all the white coverings. They ascend and descend the plant several times and migration starts in all directions. They go on dispersing from leaf to leaf and from one plant to another, but ultimately the nymphs settle down and begin to secrete the white covering material. From now onward the bugs are constantly visited by small red ants for the honey dew they secrete.

Third moulting takes place after one week. At this stage the males and females can be distinguished. The male insect migrates to a secluded place, generally in the leaf-whorls of developing shoots or underside leaves and forms a small white cocoon in which it spends the pupal period of 9-10 days. The body of the would-be male is more slender than that of the female.

Females undergo fourth moult after 8-10 days of the third moult and become adult. Near about this period the winged males also come out of the cocoon and fertilize the females. The males cause no damage to plants. Number of males is less than the females.

The bugs may be seen at every stage of development on brinjal leaves from March to October. The nymphs and adults exhibit an arrested development from November onwards and may be found in all stages among fallen leaves, in trash and in the cracks and crevices of the soil. Their activities are resumed by the end of February.

The work is being carried on under the supervision of Dr. U. S. Sharga, to whom the author's thanks are due.

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Govt. Agric. College,
Kanpur, January 12, 1953.

SCLEROTIAL ROOT-ROT DISEASE OF GROUNDNUT IN UTTAR PRADESH

DURING the year 1948, groundnut (*Arachis hypogaea* L.) was found severely affected with a root-rot disease caused by *Sclerotium rolfsii* Sacc. at Government Agricultural College and Research Farms, Kanpur. The disease appears every year, but in some years, it becomes serious and causes damage to the crop upto

per cent. or more. The occurrence of the disease in India was reported by Butler and Bisby¹ in 1931 from Bombay and Bengal States. The disease is also known to occur in Madhya Pradesh. This is the first report of the disease in the Uttar Pradesh. As the disease is an important one, attempts were made to test the resistance of varieties and strains of groundnut against the attack of *S. rolfii*.

The disease affects the yield of the crop as the affected plants produce only few shrivelled pods, majority of them are useless for seed purpose. A loss of about 23 per cent. and 50 per cent. in number of pods and their weight as calculated from diseased plants.

During the years 1948, 1949, 1950 and 1952, the average infection of the disease recorded at Kanpur was 14, 12, 15 and 9 per cent. respectively while during 1947 and 1951, the average disease infection was 3 and 5 per cent. respectively. The disease spreads rapidly during the months of August and September.

The well distributed rainfall during these months appears to favour the disease. Field observations made during 1947 to 1950 revealed that out of a collection of 61 cultures of groundnut at Research Farm, Kanpur, 15 cultures were free from infection. During 1950, 1951 and 1952, pot and field experiments were set up to test the resistance of these cultures of groundnut against *S. rolfii*. To have varied conditions of soil moisture and temperature, the crops were sown on two different dates at an interval of 20 days. The soil

was heavily inoculated with the mycelium and sclerotia of the fungus at the time of sowing and also after one month of growth of the plants. Three susceptible varieties, viz., R3, R7 and T218 were sown as checks.

In 1951 and 1952, out of the 15 varieties which were found to be resistant in 1950(2), 12 were selected for testing their resistance to the disease. Ten varieties, viz., T6-2, 11-11, 14, 16-4, 17, 19, 22, 24, 25 and 4201 maintained their resistance in pot and field experiments. Two varieties, viz., T1 and T15 were found to be slightly susceptible (below 2 per cent. infection). The varieties for checks, viz., R3, R7 and T218 showed 27.0, 10.0 and 9.0 per cent. infection respectively.

The writers are grateful to Dr. T. R. Mehta, for providing cultures of groundnut used during the studies.

Lab. of the Plant Pathologist BABU SINGH.
to Government, U.P., S. C. MATHUR.
Kanpur, December 23, 1952.

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POWDERY MILDEW, *LEVEILLULA TAURICA* (LEV.) ARN., ON A NEW HOST, *SOLANUM TORVUM* SWARTZ.

The leaves of *Solanum torvum* Swartz.* have recently been found in Bangalore to be heavily infected by the powdery mildew, *Leveillula taurica* (Lev.) Arn. Whitish, powdery, nearly circular spots are seen on the lower surfaces. Pale yellow or pale green areas are noticed on the corresponding upper surfaces, particularly when the leaves are held up against the light. The spots increase in size gradually, become irregular and coalesce with one another. In advanced stages of infection the whole of the under-surface is covered with a powdery mass, and such leaves soon drop down.

The mycelium of the fungus is endophytic, septate, intercellular, sending knobbed haustoria inside the cells. A number of thin-walled, septate and usually branched conidiophores arise through the stomata, each terminating in a conidium. The conidia are unicellular, hyaline, smooth-walled and elliptic, barrel-shaped or club-shaped. They germinate in water producing a germ tube usually from the broader end. The nature of the conidiophores and the size



FIG. 1. Showing affected plant with mycelium of *Sclerotium rolfsii* on shoots and root at ground level. Variety: R3).

and shape of the conidia agree with those of *Leveillula taurica*. The perithecial stage has not been noticed.

This is the first record of the fungus on *Solanum torvum*.

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March 22, 1953.

* The writers wish to acknowledge with thanks the help of Sri. M. Ananthaswamy Rao, Lecturer in Botany, Central College, Bangalore, in identifying the host plant.

ON THE OCCURRENCE OF *PHOMA* *CHRYSANTHEMICOLA* HOLLOS ON *CHRYSANTHEMUM* SP.

SEVERAL varieties of chrysanthemum seedlings, recently imported from Holland for a local garden, were examined in this laboratory before release. Some of them showing necrosis of the upper parts of the stems and slight root rot, were grown under quarantine conditions at the laboratory.

Some of these seedlings did not survive and an infection with a pycnidial fungus was noticed on the dead-stalks of a few of them after about 4 to 5 weeks. These were carefully removed and preserved in formalin for further examination, while the pots and soil were also properly disinfected. On examination, the fungus was found to be a *Phoma* sp., apparently not so far reported from India. The pycnidia were scattered on the stem, separate, but sometimes gregarious. They were brown, mostly sub-globose, superficial or erumpent, membranous or sub-carbonous, and measured 138-207 μ to 110-138 μ . The spores were hyaline, continuous, usually oblong or slightly elliptical, bi-guttulate, and measured 5-6 \times 1.75-2 μ .

Three species of *Phoma*, *P. chrysanthemicola* Hollos, *P. chrysanthemi* Vogl., and *P. herbarum* West have been reported on *Chrysanthemum* spp., the first from Hungary¹ and others from Italy.^{2,3} An undetermined species, considered to be a pycnidial form of *Ramularia bellunensis* Speg., is also recorded from Italy.⁴ The *Phoma* described in this paper closely resembles *P. chrysanthemicola* Hollos in morphological characters, and is, therefore, referred to the same species.

This fungus does not appear to have been recorded from Holland, but it is apparent that it was carried in the seedlings imported from that country.

The author is grateful to Dr. P. R. Mehta for advice and encouragement.

Directorate of Plant S. N. S. SRIVASTAVA.
Protection,
Quarantine and Storage,
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March 25, 1953.

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BACTERIAL SHOT-HOLE AND FRUIT CANKER OF *AEGLE MARMELOS* CORREA

IN August 1952, a bacterial shot-hole and fruit canker on *A. marmelos* was noticed in the Agricultural College Farm, Poona. The symptoms on the leaf are characterised by round, water-soaked spots (0.5 mm.) surrounded by a clear halo (Fig. 1, A). Gradually the spots

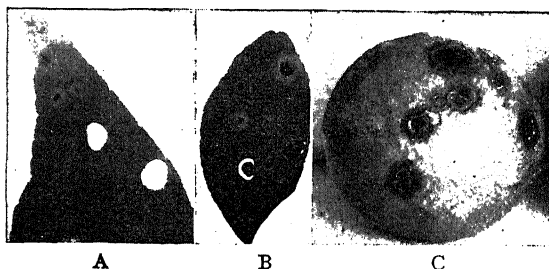


Fig. 1

increase in size (3 mm. to 5 mm.) and form brown lesions with saucer-like depressions in the centre surrounded by oily, raised margin. Many times, the few spots coalesce and the infected portion becomes chlorotic. Bacterial ooze in the form of shining beads and scales is found on both sides of spots. The primary localised lesions all over the leaf are always followed by falling out of the dead tissues leaving circular or slightly irregular perforations or "shot-holes" (Fig. 1, A). Very often, the dead portion of the lesion remains attached, though separated from the surrounding healthy tissue (Fig. 1, B).

On the fruits, the pathogen produces round, raised, water-soaked spots measuring 4 mm. to 7 mm. with no halo. After sometime, the crater-like depressions are noticeable in the centre of spots surrounded by irregular, oily, raised margins. The lesions then become very

corky, irregular in shape and chocolate brown (Fig. 1, C). The pathogen infects twigs and thorns also. On the former, large lesions (150×4 mm.) are commonly formed. The infected tissue ruptures in the centre giving a rough, corky appearance. Bacterial gummy exudation is commonly found on all infected parts.

Morphological and Physiological Characters of the Bacterium.—Short rod, single or in chains of two, gram negative, capsulated, motile by a single polar flagellum, measures $1.5 \times 0.9 \mu$. On potato dextrose agar plates, colonies smooth, convex, glistening with entire margins, consistency butyrous, 9 mm. after 4 days, naphthalene yellow; on nutrient agar plates, colonies smooth, circular with lobate margins, consistency not butyrous, ivory yellow, 9 mm. after 6 days; starch and casein hydrolysed; gelatin liquefied; acid but no gas from dextrose lactose, and xylose but not from salicin; ammonia and hydrogen sulphide produced; litmus reduced; nitrates not reduced; optimum temperature for growth 25° – 27° C., thermal death-point about 52° C., sodium chloride tolerant up to 2 per cent.

Pathogenic on *Aegle marmelos* Correa, *Citrus aurantifolia* Sw. and *Feronia elephantum* Correa. It, however, does not produce leaf canker on *C. aurantifolia*, a characteristic symptom produced by *Xanthomonas citri* (Hasse) Dowson which fails to infect *A. marmelos* and thus the present findings are in conformity with those of Lee.¹ It is proposed to name the pathogen *Xanthomonas bilva* nov. sp. after "bilva", the Sanskrit name of *A. marmelos*.

Fuller details will be published elsewhere.

Plant Pathol. Lab., M. K. PATEL.
College of Agric., S. B. ALLAYANAVARAMATHI.
Poona, Y. S. KULKARNI.
March 26, 1953.

1. Lee, H. A., *J. agric. Res.*, 1918, 15, 661–65.

CHROMOSOME NUMBERS OF CERTAIN SPECIES OF *ERIANTHUS*, MICHX.

CHROMOSOME numbers have been recorded¹ for certain forms of *Erianthus Ravenneae*, *E. munja* and *E. arundinaceus*. The numbers ranging as they do in the series $2n = 20, 30, 40$ and 60 indicate polyploidy in the genus. *E. Ravenneae* has $2n = 20$, while the higher numbers occur in both the species *munja* and *arundinaceus*. In the *Chromosome Atlas*² record has been made of the chromosome numbers of *E. elegans* ($2n = 40$), *E. sara* (bengalense) ($2n = 60$) and *E. arundi-*

naceus ($2n = 40$ and 60). In *E. maximus* Brongn., native to New Caledonia and Fiji Islands, all multiples of 10, from $2n = 60$ to $2n = 100$ have been recorded.³

Chromosome counts have now been determined for four more species of the genus, viz., *E. fulvus*, *E. elephantinus*, *E. Hookeri* and *E. longisetosus*, live specimens of which have been collected from various parts of India in the course of the work of the Spontaneum Expedition Scheme. In the case of *E. fulvus*, the counts are from root-tips, while in the others, the counts are from clear meiotic plates of pollen mother cells, observed in iron-acetocarmine smears. Forms of the same species collected from different areas (Assam, Nepal, Kumaon, etc.) possess the same number.

| Species | No. of forms examined | Locality of collection | Chromosome number observed |
|---------------------------------------------|-----------------------|-----------------------------------|----------------------------|
| <i>E. fulvus</i> , Nees ex Steud. | 2 | Kangra Hills and Nepal | $2n = 20$ |
| <i>E. elephantinus</i> , Hook. | 2 | Kumaon and Lower Assam Valley | $n = 10$ |
| <i>E. Hookeri</i> , Hack. | 2 | Assam and Tirap Frontier, NEFA | $n = 15$ |
| <i>E. longisetosus</i> , Anderss. ex Benth. | 2 | Lower Assam Valley and Naga Hills | $n = 15$ |

This is presumably the first record of the chromosome numbers of these species. The numbers confirm the occurrence of polyploidy in the genus. Within the range of the species so far examined, the lowest number $2n = 20$ is found in *E. Ravenneae*, *E. elephantinus* and *E. fulvus*. The three 20-chromosome species differ from each other to a much greater extent than the two 30-chromosome species do, in respect of both vegetative and floral characters. The differences between *E. Hookeri* and *E. longisetosus* are much less conspicuous and more minute than the differences between *E. Ravenneae*, *E. fulvus* and *E. elephantinus*. Within the range of species studied by us, there does not appear to be either a close positive or negative relationship between the size of the plant and the chromosome number. Further investigations are in progress.

Sugarcane Breeding Inst.,
Coimbatore, April 15, 1953.

J. T. RAO.
C. N. BABU.

1. Subba Rao, K. S. and Raghavan, T. S., *Proc. 1st Bienn. Conf. Sug. Res. Workers, India, Bot. Sec.*, 1951. 2. Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1935, 3, Grassl, C. O., *Journ. Arn. Arb.*, 1946.

REVIEWS

Crime Investigation—Physical Evidence and the Police Laboratory. By Paul L. Kirk, Ph.D. (Interscience Publishers Inc., New York).

With the advancement of science, its applications to crime detection have also increased a great deal, and though there are not many well-equipped forensic science laboratories in our country, the investigating officer is beginning to recognise the value of scientific aids and is summoning expert assistance more and more to aid him in the detection of crime. This valuable book, although written with American conditions in view, will greatly help police scientists and investigators to have an idea of the various ways in which modern science can aid in crime detection. As the author has stated in the preface, it is necessary for the investigating officers not only to know how to collect and preserve physical evidence but also to understand what to collect and *why* it should be collected. All this information is made available to him in this book.

The first section deals with many interesting and useful subjects, such as organisation of the police laboratory museum, equipment for investigation, clothing, fibres, blood and other physiological fluids, glass, soil, paint, metals, vegetable materials, casts, tracks and traces, tool marks, fire arms, fires, explosions, finger prints, poisons, documents and photography, besides a very useful chapter on the expert witness. The second section deals with the design and organisation of the laboratory, procedures for determining physical properties, such as density, refractive index, etc., tests for common chemical constituents, spectrography, absorptiometry and laboratory examination of hairs and fibres, stains, blood and other physiological fluids, broken glass, soils, paints, fire arms, tool marks, evidence from fires, explosives, finger prints, poisons and documents.

While dealing with the tests for blood, the author mentions chemical luminescence as a test of great value, that it is comparatively though not completely specific and that it does not interfere with subsequent tests of the same or other types. It may be mentioned here that some work has been done on this test in Madras (Naidu and Pitchandi, *J. Proc. Inst. Chem.*, 1943, 16, 94; *Analyst*, 1944, 69, 98) and be-

sides finding that some vegetable juices such as of the prickly pear gave positive results to this test, it was also shown that blood stains on rusty implements, earth and vegetable tissues disintegrated after treatment and hence only a portion of the stain and not the whole stain should be used for this test.

The matter in this book has been presented in a simple form and it will be interesting to non-technical readers also. Every police officer interested in modern scientific criminal investigation will profit greatly by going through this book. The second section of the book, in particular, will also be of great help to workers in forensic science laboratories.

N. PITCHANDI.

Applied Electricity. By H. Cotton. (Cleaver-Hume Press Ltd., London), Second Edition, 1953. Pp. xii + 482. Price 18 sh. 6 d.

Dr. H. Cotton is well known to students of electrical engineering through his excellent text-books; and this new book is a welcome addition to the series. The author claims in the preface that the book has a two-fold object: first, to provide a sound and comprehensive guide to the fundamental principles of applied electricity, and secondly, to cover the requirements of the syllabus in the subject of Part I of the London B.Sc. (Eng.) Degree. The syllabus for applied electricity differs from that for the old subject—electrical technology—mainly in regard to the amount of fundamental knowledge of magnetism, electrostatics and electromagnetism required. There is no doubt that the author has succeeded in his task admirably. The book is complete so far as the particular subject is concerned and there is no need for the student to refer to other works. In fact, the scope of the book is such that it covers a little more than the minimum examination requirements, and can well be used for general reference. The large number of worked examples and answers to the comprehensive collection of examples at the end of the book should be of considerable assistance to the examination student.

The volume under review, which is the second edition of the book first published in 1951, has been slightly enlarged and includes sections on the M.K.S. system of units, the triode valve and the photocell and a chapter on circle diagrams.

The book is printed on good quality paper and the general format is attractive and the price is reasonable. It can be strongly recommended to all students of electrical engineering.
H. N. RAMACHANDRA RAO.

Power Cables: Their Design and Installation, Vol. 14. (*Monographs on Electrical Engineering*.) By C. C. Barnes. (Chapman & Hall, Ltd.), 1953. Pp. 272. Price 35 sh.

The basic design and engineering data used by cable engineers when dealing with enquiries and orders for power cables, have been ably reviewed in the monograph under notice.

In regard to cable identification and assembly of multi-core cables, the author discusses in some detail the present position of aluminium as sheath material in place of lead. Though aluminium sheath is generally found to be superior to lead alloy, the author has rightly pointed out that long-term experience in the behaviour of aluminium in contact with soils is still to be obtained. In discussing the mechanical protection of the lead cable, the author has also touched upon the use of non-magnetic armouring for a single-core cables. A chapter is devoted to the testing requirements of power cables. Calculation of cable dimensions and weights are dealt with in detail and necessary data are given for computing the weight of the component parts of the cable.

Two chapters deal with the subject of permissible current and intermittent ratings of cables including short circuit ratings. The review of the many factors involved in determining the permissible current rating of power cables is particularly useful in view of the present position regarding heavy loadings on cable networks. The effects of thermal resistance, of bedding and serving, and also of the soil on the current rating of cables have also been discussed.

Two chapters are devoted to the discussion of the present state of development of super-voltage cables in England and abroad. It has, however, been rightly pointed out by the author that the information is only an outline; the various theoretical and practical problems associated with super-voltage cables are still far from having been finalized.

Three chapters are devoted to the various aspects of power cable installation such as depth of laying, bonding and earthing, effect of grouping of cables, and jointing and terminating of power cables including gas pressure systems. Modern submarine cables and their installation are considered in a separate chapter. A

short reference has been made to the subject of D.C. transmission and the various factors involved. The problems of cable faults and their localization and the care and maintenance of cables including tests on site are treated in two chapters.

In addition to various cable data provided in the different chapters, a large amount of additional data and information on cable characteristics, terms used in cables technology, reference to B.S. specifications, impulse testing of cables, etc., are provided in the Appendix. An up-to-date bibliography makes the book useful as a reference book.

The volume is bound to be very useful to electrical engineers and students interested in the practical or theoretical aspects of the design, manufacture or installation of paper insulated power cables.

C. S. GHOSH.

Advances in Geophysics, Vol. I. By H. E. Landsberg. (The Academic Press, Inc., New York), Pp. xi + 362. Price \$7.80.

This book gives a summary of the latest advances in the several branches of geophysics. Bellamy gives an account of the automatic processing of geophysical data. The shortcomings of automatic equipment are their inability to produce output records, capable of convenient and efficient mental assimilation and interpretation. He is in favour of unitary digital notations for all records of observational data with some exceptions. Arnold Court discusses some new statistical techniques in geophysics. A combination of classical probability theory and the very recent theory of extreme value permits actual analysis and evaluation of the extremes of many geophysical elements. The theory of extreme values provides a reasonably accurate method of estimating the expected extremes for any given period, say, the highest temperature, strongest wind, severest earthquake, greatest magnetic disturbance or worst flood.

Bert Bolin gives a study of the general circulation of the atmosphere. Non-uniform heating of the earth and the atmosphere is the ultimate cause of motion. A meridional circulation cell is the predominant mechanism for momentum exchange in the tropics. The theory of general circulation is based on the turbulent motion produced by the thermal contrast between equator and the poles. The influence of the non-uniformity of the surface of the earth is the cause of monsoons. Whipple gives the method of exploring upper atmosphere by

meteoric techniques. He describes the visual, photographic and radio methods. By the drag equation, equation for the loss of mass, and equation for luminous intensity, the density of the atmosphere is calculated. The conclusion is that a constant stratospheric temperature to great altitudes is inadmissible. Gerson states the unsolved problems in physics of the atmosphere. The chief of these are, (1) the origin of sporadic E, (2) the stratification of ionic layers—like D and E, and F_1 and F_2 , (3) the response of solar activity to SID and magnetic storms, and (4) formation of the aurora and the origin of the geomagnetic field.

Pritchard discusses estuarine hydrography. He gives the theory of Stommel and Cameron on the dynamics of an estuary, the flushing of an estuary, the tidal prism concept, salt balance, and the length of flushing on Ketchum's theory. Woodlard discusses the earth's gravitational field and its exploitation. He explains the application of Bouger gravity anomalies to geologic structure, and the support given by it to isostasy. Balsley describes aeromagnetic surveying, the instruments, their use and typical surveys made.

The book is an excellent summary, by experts, of the latest advances in geophysics, and is an invaluable asset to both students of geophysics and to seekers after knowledge.

P. R. J.

Radiations and Living Cells. By F. G. Spear. (Chapman & Hall, Ltd.), 1953. Pp. xii + 222. Price 18 sh. net.

The exact mechanism of action of penetrating radiations on living cells is still not perfectly understood and a great deal of more experimental work has to be done to throw more light on this important problem. The volume under review, which deals succinctly with the action of ionising and penetrating radiations on the living tissues, normal and pathological, is therefore most welcome.

The author's long experience in teaching post-graduate students of radiology and his lucid presentation render this difficult subject of radiation biology easy to read and digest. The effect of ionising radiation, particularly on important tissues such as blood, skin and reproductive organs, has been dealt with in great detail. The chapters dealing with the effect of radiation on other living tissues are also equally instructive. The task of compiling the widely scattered literature on the subject, and presenting it in the form of a handy book like this, has been accomplished with great distinction.

This book can legitimately be accepted as a text-book on radiation biology for post-graduate students preparing for diploma course in radiology. To research students in radiation biology and to all who are engaged in the practice of radiation as a method of diagnosis and treatment, this book will serve as a very useful guide. This book will be a useful addition to any library.

YUSUF SMIRQ.

Progress in Nuclear Physics, Vol. 2 (Published by Pergamon Press Ltd., London), 1953. Pp. viii + 294. Price £ 3 3 sh.

Volume II of the *Progress in Nuclear Physics* is the continuation of a programme of reviewing some of the important problems of modern nuclear physics by those working on these particular problems. The purpose of these reviews as explained by the editor, Prof. O. R. Frisch, is to supply information and references to persons either not directly working on these problems or to those seeking an introduction to it. In this object the volume has succeeded to a great extent. The lack of space and immensity of some of these subjects naturally make some of the articles a review of references.

The subjects dealt with in this volume are : (a) The electron optical properties of magnetic β -ray spectrometers (Vester) in which the theory and construction of different possible designs of β -ray spectrometers are reviewed; (b) Nuclear paramagnetic resonance (Pound) deals with the experimental details and theory of the more recent methods of measuring nuclear spins; (c) Luminescent materials for scintillation counters (Garlick) is a survey of the properties of crystals and liquids for use with photomultipliers as scintillation counters. The fundamental mechanism of light emission in phosphors is also briefly discussed; (d) The neutron-proton interaction (Squires) is an introduction to the theoretical work on the neutron-proton interaction using the effective range theory. A comparison with experimental results is also discussed; (e) Nuclear fission (Whitehouse) is a collection of facts of all that is known about the fission of nuclei including a brief discussion of the liquid drop theory and the asymmetry of fragments; (f) The lowlying excited states of light nuclei (Burcham). This section is divided into three parts, the first of which deals very briefly with the attempts to theoretically describe the energy levels of light nuclei on various nuclear models. The second describes the experimental methods of determining these energy levels by the methods of scattering and nuclear disintegration, and the interpretation of

experimental data. The third is an analysis of the level schemes of mirror nuclei and isobars; (g) The nuclear shell model (Flowers): The idea of a shell structure in nuclei is an important recent development in nuclear theory. This section deals with the reason why it has been necessary to postulate it and describes its successes in explaining many experimental facts; (h) Ionisation by fast particles (Cranshaw). The study of ionisation by fast particles is a very important one in the determination of energies of particles encountered in cosmic radiation. A brief theoretical description of the process and its experimental applications are described here.

R. RAMANNA.

Elements of Nuclear Reactor Theory. By Samuel Glasstone and M. C. Edlund. (Mac-Millan & Co.), 1953. Pp. 416. Price 35 sh.

Nuclear reactor theory is of considerable interest to two classes of readers: those interested in its extreme practical importance for the development of atomic energy, i.e., nuclear power, and those primarily interested in the theoretical problems of neutron diffusion which have resulted in the development of new and advanced mathematical techniques for the solution of integral equations. To both these classes of readers, the book serves as a valuable introduction.

Most of the literature on this subject, especially relating to its practical application, is still on the 'secret' list due to security regulations. But even such information as is available, can be found only in the original papers in various scientific periodicals and documents not easily accessible in many libraries. The previous books on the subject were monographs either on an elementary level or dealing only with a few of the problems. Probably this work is the most coherent "text-book" on the subject now available to young researchers who wish to have a thorough knowledge of the fundamentals of nuclear reactor theory.

The authors have attempted to satisfy readers with varying backgrounds of scientific knowledge. Hence the book opens with elementary chapters on nuclear structure and stability and nuclear reactions which should serve as an introduction to those totally unacquainted with nuclear physics. In trying to meet the needs of such readers, the authors perhaps explain too much or tend to be repetitive in some of the descriptions of nuclear processes. But the subsequent chapters on the production and reaction of neutrons and neutron diffusion should satisfy anyone who wishes to be initiated into nuclear research.

The chapters most interesting to the theoretical physicist are those on the diffusion and slowing of neutrons in homogeneous and heterogeneous reactors and the final chapters on transport theory, all of which serve as valuable preliminary study for a proper understanding of advanced papers on the subject, for example, the classic article of Marshak in *Reviews of Modern Physics* or the recent work of Chandrasekhar and Kourganoff on transfer problems.

To students in Indian and probably Western European Universities, where even declassified atomic energy reports and memoirs are not easily available, this book written by an author of such established reputation like Samuel Glasstone in collaboration with Dr. Edlund, is probably the only satisfactory "source book" on reactor theory. It is particularly valuable to students of physics in India most of whom have no opportunity to have any acquaintance with the problems of nuclear physics.

A. RAMAKRISHNAN.

Vacuum Technique. By A. L. Reimann. (Chapman & Hall, London), 1952. Pp. ix + 449. Price 50 sh.

High vacuum techniques have found wide application in some form or other in various branches of science and technology. In fact, the time is probably ripe for the introduction of a regular course in high vacuum engineering in some of our Universities. If such a course is instituted, Dr. Reimann's book will form an ideal text-book for study, since it covers not only the technical aspects of the subject, but also goes into the physics and chemistry of the various processes. The book could also be consulted with profit by research workers in various branches of physics, as it contains a wide range of information, not readily found in such a collected form.

Two chapters deal with backing pumps in general and a discussion of their performance. Molecular and diffusion pumps for high vacua are described in the next three chapters which contain many useful practical hints. A long chapter of 50 pages contains a discussion of pump systems and pumping procedures in general, and in particular with methods of leak detection, construction of demountable and flexible joints, introduction of pure gases into a vacuum system and so on. Glass blowing techniques and the details of making various glass to metal seals occupy more than 100 pages. Methods available for cleaning up the residual gases in a sealed system are considered in a separate chapter and the book closes

with a discussion of various types of vacuum gauges.

Each chapter contains a bibliography listing a number of references to original literature and there is a good index at the end of the book. Altogether a comprehensive volume, the book should be considered moderately priced for the valuable amount of information contained in it. It must find a place in the library of every scientific and technical laboratory.

G. N. RAMACHANDRAN.

Radio Research Special Report No. 25 (*Select- ed Problems in the Preparation, Properties and Application of Materials for Radio Pur- poses*). (Published by H.M.S.O., London). Price 1 sh. 6 d.

An important factor in the progress of radio communications has been the development of new materials and their use in new devices of improved performance. The principal classes of radio materials are conductors, semi-con- ductors, dielectrics and magnetic materials. Knowledge of the properties and behaviour of conductors is well advanced and suitable mate- rials in this class are available for almost every required service. The properties of the other three classes of materials are not so well understood and a great deal of work remains to be done before their behaviour in all con- ditions can be completely predicted.

This pamphlet is based on the work of several groups of experts who have studied the present state of knowledge of ceramics, organic polymeric dielectrics, magnetic materials and semi-conductors. The report is divided into sections dealing with these materials, each section outlining existing knowledge and stat- ing the research problems which most urgently need attention if the material is to be fully exploited for radio purposes.

General Properties of Matter. By C. J. Smith. (Edward Arnold & Sons), 1952. Pp. 580. Price 50 sh.

With the enormous developments that have taken place in *Modern Physics* during the last 30 years and the large number of text-books that have appeared in this field, there has been noticed a tendency in recent years to lay emphasis on the newer trends of physics and to neglect subjects like 'Properties of Matter'. In fact, very few good books have appeared on this subject since the publication of the clas- sical text-book by Poynting and Thompson. We, therefore, welcome this eminently readable book by C. J. Smith, whose *Intermediate*

Physics must be familiar to most of our read- ers.

The book under review is the first of a series to be published under the title *A General Degree Physics*. It deals with the conventional field of general properties of matter in a fairly orthodox and rigid manner. The chapter on the flow of liquids and solids contains much new material, particularly, interesting details of recent work on the flow of solids and non-Newtonian liquids.

A mathematical introduction helps the First Year Honours student to grasp the basic mathe- matics required for studying the book. Several new experiments have been added, which should make laboratory work extremely inter- esting. Of special significance are the problems given at the end of each chapter. The young aspirant for the Honours Degree should aim at working out the entire collection. The histori- cal background of each chapter is admirably presented, enabling the reader to appreciate the difficulties of the early workers in the field. It may be mentioned in passing that experienc- ed teachers may not find it easy to reconcile themselves to the metamorphosis of 'accelera- tion due to gravity' (the familiar g) into 'inten- sity of gravity'.

It cannot be gainsaid that students and teach- ers of physics will find much in the book which will be useful and stimulating. We await with interest the other text-books of the series by the same author.

S. R. R.

Starch and Its Derivatives. Vol. I. 3rd Edition.

Edited by J. A. Radley. (Publishers: Chap- man & Hall Ltd.) Pp. 510. Price 65 sh. net.

Notable advances have been made in recent years, particularly in the United States, in the elucidation of the structure, chemistry and behaviour of starch, and Mr. Radley in editing this book has very wisely enlisted the co-opera- tion of prominent workers in the specialised fields of starch chemistry and technology, both in the United States and in the United Kingdom to write special articles on different aspects of the subject.

In Part I of this volume, there are 17 chap- ters dealing with the structure and reactions of starch, while in Part II are found 7 more deal- ing with amylases and their action on starch. All the chapters have been written in a concise and authoritative manner, with extensive refer- ences to literature. The chapter on waxy cereals and starches deserves special mention since a comprehensive account of the botany, genetics and agronomy in addition to the chemistry of these materials has been presented.

One may perhaps criticise the manner in which in a third edition published in 1953, methods introduced as long ago as 1937 and 1941 have been dealt with (pages 91 and 119), as though they were very recently worked out. Further, the role of inositol as an active constituent of pancreatic amylase is very briefly dealt with in page 372, overlooking the later investigations of Fisher and Bernfield and others on this subject. However, these are only minor blemishes in what is otherwise a very commendable effort. Undoubtedly, this volume can be considered as a most comprehensive and up-to-date treatise on the subject of starch and its derivatives.

P. S. SARMA.

Specifications for Insecticides. (Fourth Report of the WHO Expert Committee on Insecticides.) (World Health Organization Technical Report Series, No. 54.) Pp. 98. Price 5/-.
New standards, replacing those recommended at previous sessions, were adopted for the following insecticides: technical DDT, technical benzene hexachloride (BHC) and its concentrates, technical methoxychlor, technical chlordane, water-dispersible powder concentrates of DDT and of BHC, and DDT emulsion concentrates. Technical dieldrin, pyrethrum extract, and certain emulsion concentrates were among other substances considered for which standards were formulated.

Specifications for aerosols, diluents, solvents and emulsifiers, as well as certain data on the preservation of insecticides under various climatic conditions, are also to be found in the report. In addition to the description of test procedures, the annexes contain sampling instructions, and on account of a provisional method for testing aerosols which has been successfully employed in the United States of America.

Books Received

Text-Book of Genetics. By William Hovanitz. (Elsevier Publishing Co., Ltd.). Pp. xii + 420. Price 42 sh. 6 d.

The Geology of Ireland. By J. K. Charlesworth. (Oliver & Boyd, Ltd.), 1953. Pp. xvi + 276. Price 25 sh.

Methods and Principles of Systematic Zoology. By Ernst Mayr. (McGraw-Hill Book Co., New York), 1953. Pp. viii + 328. Price \$ 6.00.

Chemical Constitution. By J. A. A. Ketelaar. (Elsevier Publishing Co.), 1953. Pp. viii + 400. Price 40 sh.

High Energy Nuclear Physics. Compiled and Edited by H. P. Noyes, H. Camac and W. D. Walker. (Interscience Publishers, Inc.). Pp. 110. Price \$ 2.00.

Chromosome Breakage. Symposium held at the John Innes Horticultural Institute. (Oliver & Boyd, Ltd.), 1953. Pp. viii + 316. Price Rs. 45.

Text-Book of Optics. Second Edition. By N. K. Sethi and S. B. Raizada. (Premier Publishing Co., Delhi), 1953. Pp. 431. Price Rs. 10.

Geometrical Optics. By C. Curry. (Edward Arnold & Co.), 1953. Pp. viii + 174. Price 35 sh.

The Stability of Rotating Liquid Masses. By R. A. Lyttleton. (Cambridge University Press), 1953. Pp. 150. Price 35 sh.

Flames, Their Structure, Radiation and Temperature. By A. G. Gaydon. (Chapman & Hall), 1953. Pp. xii + 340. Price 55 sh.

Facts, Files and Action, Part II. By Holmstrom, Ph.D. (Chapman & Hall), 1953. Pp. xvi + 280. Price 32 sh.

Projective Geometry and Projective Metrics. By Herbert Busemann and P. J. Kelly. (Academic Press Inc.). Pp. viii + 332. Price \$ 6.00.

Theory of Equations. By Prof. H. W. Turnbull. (Oliver & Boyd). Pp. xii + 166. Price 6 sh. net.

Integration of Ordinary Differential Equations. By E. L. Ince. (Oliver & Boyd). Pp. viii + 146. Price 7 sh. 6 d. net.

The Astonishing Atom. By John Rowland. (E. J. Arnold & Son Ltd., London). Pp. 120. Price 4 sh. 6 d. net.

International Council of Scientific Unions, 1952. Vol. VI. (Cambridge University Press), 1953. Pp. viii + 158. Price 7 sh. 6 d.

Primates—Comparative Anatomy and Taxonomy. (I-Strepsirhini). By W. C. Osman Hill. (Edinburgh University Press). Pp. xxiv + 798. Price £ 5 5 sh.

Endosymbiose Der Tiere Mit Pflanzlichen Mikroorganismen. By Paul Buchner. (Verlag Birkhauser, Basel/Stuttgart). Pp. 772. Price S. Fr. 66.50.

Chemistry of Carbon Compounds, Vol. II. (Alicyclic Compounds). Edited by E. H. Rodd. (Elsevier Publishing Co.), 1953. Pp. xx + 486. Price £ 4 4 sh.

SCIENCE NOTES AND NEWS

Total Synthesis of Cortisone

A new method of making cortisone from simple, readily available chemicals devised by Dr. Lewis H. Sarett and a group of research chemists of Merck and Company, Inc., has been recently announced. An interesting feature of the synthesis is that the essential oxygen atom at position 11 of the cortisone molecule is built into the nucleus right from the beginning. An oxygen atom in one of the starting materials, benzoquinone, is retained throughout the synthesis, finally becoming the 11-oxygen of the cortisone structure. Dehydrocorticosterone and 11-ketoprogesterone were synthesized as a part of the procedure. It is also relevant to add that through the many improvements in the manufacturing process, cortisone is now readily available at a price less than a tenth of the original figure.

Radio-active Iodine for Goitre

Radio-active iodine, produced by exposing iodine to atomic radiation, has proved successful in treating toxic goitre.

Used both as a tracer and in treatment, its success is due in part to the avidity of the thyroid gland for iodine. After a dose is given, most of the iodine is soon concentrated in the thyroid gland, while the rest is thinly distributed throughout the rest of the body. A healthy thyroid gland absorbs about 500 times as much iodine as an equivalent amount of any other organ or tissue; an overactive thyroid from 1,000-1,500 times as much. Thus a tracer dose of radio-active iodine will show quickly and accurately the state of the thyroid's health and activity. If the tracer does confirm the diagnosis of hyperthyroidism, a much larger dose is administered and the radio-active atoms, on reaching the thyroid gland, destroy enough thyroid cells to reduce the harmful overactivity of the gland.

Ship Testing at Poona

The ship-testing tank recently installed at Poona with the aid of a UNESCO grant is part of a 120-acre outdoor laboratory covered with miniature models of harbours and rivers. Models can be driven through it, suspended from a 3-ton carriage 30' long and riding on rails 14' apart.

Experiments in ship-testing tanks are usually made with models of wood or paraffin wax

upto 15' in length. The carriage at Poona is capable of driving a model at a speed of 16 miles per hour but, in actual practice, it will run much more slowly. Two miles an hour is usually sufficient to test a scale model of the hull of an 8,000-ton ship.

While the model is being towed through the tank, instruments register its resistance and, at the same time, photographs are taken of its bow wave and wake; later, the model can be tested with a wave-generating machine in the tank to show how the full-sized ship will behave in high seas. The tests at the Poona tank are being carried out under the direction of C. V. Gole, an Indian engineer.

Eighth Pacific Science Congress

The Eighth Pacific Science Congress will be held in Philippines on November 16-18, 1953. A number of symposia relating to oceanography, geology, geography, anthropology and biology pertaining to that region have been arranged. Among the International Organizations participating in the Congress are the UNESCO, WHO and FAO.

UNESCO Grant for Study of Desert Animals

Jaswant College, Jodhpur, has been awarded a grant of \$2,835 by UNESCO for a study of the habits of wild and domestic animals in the desert of Rajputana and their role in the maintenance, and even the spread, of desert conditions there. The work will be started in July under the direction of Dr. Daya Krishna, Professor of Zoology at the College.

Allahabad University

Prof. S. Ghosh has succeeded to the Chair of Chemistry at the Allahabad University in the place of Prof. N. R. Dhar who has retired after a distinguished record of service in the University.

Dr. K. A. Chowdhury

Dr. K. A. Chowdhury, Wood Technologist, Forest Research Institute, Dehra Dun, has been invited by the Organising Committee of the Eighth International Botanical Congress to be held in Paris in July 1954 to be a Vice-President of the Palaeobotany Section, and to preside over the symposium on "Fossil Woods—Convergent Wood Structure".

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TROPICAL BUILDING DESIGN AND CONSTRUCTION

THE design and construction of buildings in the tropics raises many problems in view of the variety of climates that obtains in the region and the conditions of living which are economically backward. These were considered by a large group of experts at a symposium* held in Delhi, with a view to assess the part which science can play in their solution.

Discussing the general principles of building design in the tropics, it was pointed out that each climatic sector called for individual interpretation and treatment by the designer. These sectors are marked off from one another by variations in climatic factors such as direction and intensity of wind, temperature range and relative humidity, distribution of rainfall and duration and intensity of solar radiation. But it would appear that in many constructions in this region, these climatic factors have not been suitably taken into account. The symposium, therefore, recommended that a wider use be

made of tabular climatic data and charts as are already available in each iso-climatic sector and that steps should be taken to supply the deficiency in the other sectors also.

The physical features of the site, such as slope, tree cover, etc., play an important part in the layout of a building. Thus, advantage can be taken of natural slopes to provide for easy drainage and sewage disposal. It was pointed out similarly that dwelling consisted not only of the space within the plinth area, but included also part of its immediate surroundings. Thus, trees appropriately sited near the house, provided outdoor living space below them, for the family and for guests; also such trees could afford, if suitably situated, protection against direct sun rays, wind and rain to the inmates, and protection also to the building itself. The symposium in this connection also recommended that there should be provision of space for vocational work and shelter for domestic animals, and that a survey should be made of traditional building methods and local forms of house design and construction in the

* Report of the Regional Symposium held on the subject in Delhi during December 1952.

different parts of the region, showing in particular, their relationship to climate and indigenous materials.

In regard to building materials it was felt that until the availability of cement increases, concrete would find its application mainly in cities where there was a paucity of other suitable building materials, and also for large public constructions in areas within easy reach of cement factories or a sea port. Several papers in the symposium were directed to a discussion of the properties and uses of light-weight concretes, using locally available aggregates; special attention being given to vermiculite, since sizable deposits of it were available in Mysore and West Bengal. Other important light-weight aggregates referred to, were volcanic ashes, obsidian, rice husks, wood wool, bagasse and other vegetable fibres. There seemed, however, to have been little scientific research on the use and development of these light-weight concrete materials. Reference was also made to aerated concrete and particularly, to the use of *ritha* (the fruit of a tree resembling the tamarind and containing 25 per cent. saponin) as a foaming agent; however, there did not seem to be any long-range experience in the use of this reagent.

In this connection, the following are some of the recommendations of the symposium: (1) further research into the long-term behaviour of light-weight concretes, especially those made from organic aggregate materials, should be undertaken; (2) facilities for the study of better brick-making processes should be provided; (3) improved uses in building of earth, particularly in a stabilised form, should receive wider publicity, since this material has good potentialities in many areas, and that building material testing laboratories, distributed throughout the area, be made responsible for the testing and control of improved earth building; (4) the use of laminate and treated timber should be encouraged immediately; and (5) composite bamboo-concrete construction is to be investigated thoroughly by a recognised authority.

With reference to construction practice and vocational training, it was felt that University

courses in Engineering and Architecture may advantageously include adequate training in the technique of job organization and labour management at site level. Also, adequate vocational training schemes should be provided for workers in the building industry, and provision made to keep them abreast of the latest developments in their particular fields. Especially, long-term building programmes should be designed wherever possible, so as to ensure that workers may become proficient at their job and also with a view to reduce fluctuations in the use of plants and labour man-power.

A number of papers were presented at the section relating to provisions for comfort, sanitation and public health. As a result of the discussion, the symposium recommended that investigations be made in different climates of the region to determine the thermal insulating behaviour of different wall and roofing constructions so as to provide more comfortable conditions indoors during extreme changes of weather. It was also suggested that a special symposium should be organised to deal with the problems of sanitation, water-supply and other health aspects of housing.

A special section was devoted to a consideration of the organisation of research, testing procedures, the maximisation of the results of research through standardization and the use of building information services. A very useful report by ILO surveyed building research and experimentation already carried out in the Asian region. At length, the symposium resolved that national bodies, similar to the Indian Standards Institution, be set up elsewhere in the region and that consideration be given to the possibilities of Shape Engineering in effecting substantial economies in both steel and reinforced concrete structures, with due regard to factors of corrosion, fire resistance, manufacturing limitations and structural stability. Having noted with satisfaction the establishment of the INSDOC, it was suggested that in order to ensure adequate provision, exchange and dissemination of scientific and technical knowledge on all aspects of building design and construction, steps may be taken to set up a more specialised Building Information Service at an early date.

KALINGA AWARD FOR 1953

THE Kalinga Award for distinguished popular writing in science was made this year to Dr. Julian Huxley, at a ceremony in Paris on July 2. Dr. Huxley, who was UNESCO's first Director-General, had been nominated for the

prize by both the Royal Society of Great Britain and the Institute de France. The first award, in 1952, went to the French scientist, Prince Louis de Broglie.

DIASTROPHISM AND EVOLUTION

L. RAMA RAO

SO far back as 1909, Prof. Chamberlin put forward the view that 'diastrophism is the ultimate basis for dividing geologic history' and maintained that 'in these deformative movements, there seems to be a universal, simultaneous, and fundamental basis for the subdivision of the earth's history'. During all these years, this question in some form or other has been the subject of much discussion and controversy among geologists and palaeontologists all over the world. With a view to critically examine and take stock, as it were, of the present position in this fascinating field of study, a comprehensive symposium was recently organized in America under the striking,—nay, sensational,—title "Distribution of Evolutionary Explosions in Geological Time", an account of which has been published in the *Journal of Palaeontology*.* The various papers contributed to this symposium by distinguished workers in the different fields of research serve to indicate the many lines of possible approach to the study of this problem, and reveal the complicated interrelationships involved in their mutual correlation. The main problem is to discuss how far Prof. Chamberlin's concept is acceptable to-day in the light of the known facts of palaeontology and evolution, in relation to diastrophism.

As pointed out by Dr. Lloyd G. Henbest in his opening address to the symposium, the logic of Prof. Chamberlin's dictum rests on certain postulates as follows: (i) that diastrophism is periodic and synchronous on a worldwide scale, and (ii) that diastrophism is a major control, if not the principal stimulus, of organic evolution; and therefore (iii) that organic evolution and crustal movements conform to the same worldwide rhythmic pattern. On the basis of recent studies, geologists, biologists and palaeontologists will readily realise that on both the premises (i) and (ii) there is considerable and sharp difference of opinion to-day, and that therefore the conclusion (iii) rests on very uncertain foundations. After pointing out the several ways of constructing and calibrating a geologic time-scale, and discussing their relative dependability, Dr. Henbest shows that anything like a worldwide break or a worldwide unconformity is an inconceivable proposition from the known facts of geological processes of erosion and sedimentation, and that the idea of a 'pulse' or 'rhythm' in denoting the periodicity

of geological and biological changes in time, is being overdone.

From the palaeontological side, which is perhaps the most important in this study, Dr. Arthur Cooper and Prof. Alwyn Williams, in their paper, have examined the evidence and significance of the stratigraphic distribution of Brachiopods in the consideration of this problem. Their survey shows that while it is true that there seem to be certain evolutionary 'bursts' in the history of the Brachiopods, these 'are distributed in time serially, and without very clear relation to the geologic periods' and that 'they show considerable provinciality'. In another paper, Prof. Raymond C. Moore looks at the problem from the point of view of the evolution rates among Crinoids,—a group which he says is specially suited for the study of evolutionary trends and rates 'because of the complexity of their skeletal organization, remarkable range of adaptive variations, long geologic history, and abundance of described species'. After analysing the evidences furnished by the different species of this group, and presenting them in the form of nice graphs, Prof. Moore points out that this survey 'calls attention to stratigraphic and regional concentrations which seem to signify an acceleration of specific differentiation that is more or less localized in time and space' and reveals that there is a 'noteworthy tendency for maximum proliferation of species in middle divisions of geologic systems'. In two succeeding papers, this problem of periodicity in evolution has been fully discussed,—Dr. Norman D. Newell looking at it from the point of view of Invertebrates, and Dr. George Simpson, of Vertebrates. These two papers may generally be considered to support the view that 'the fluctuations in evolutionary activity are not directly related to times of widespread orogeny, and that there is no indication that peak times of evolutionary activity correspond with times of extensive orogeny'. After the reading of these papers, there was a lively discussion; and the consensus of opinion at the end of the symposium was that while it was true that environmental changes have an influence on evolution, they constitute only one of the many factors affecting the trend and pace of evolutionary changes, and that therefore any intimate and exclusive relationship between Diastrophism and Evolution as was implied in Prof. Chamberlin's dictum is altogether unacceptable to-day.

* *Journal of Palaeontology*, May 1952, 26, No. 3.

It must, however, be realised that the subject-matter of this symposium deals with certain fundamental issues which constantly come up for consideration in dealing with several geological problems, especially in the field of biostratigraphy and geochronology. Here in India, for instance, we have quite a number of problems of stratigraphical classification and correlation in the discussion of which questions relating to the origin and evolution of life forms have to be considered on the lines embodied in the symposium. One of the most important of such studies is that dealing with 'Boundary Problems'; and the present writer's papers on the 'Cretaceous-Eocene boundary' in India will serve as an example to illustrate this point.

Then again, we have the problem of what look like "discrepancies between the chronological testimony of fossil plants and animals", and these require clarification. Indian stratigraphy offers many such problems; and these were discussed some years ago at the Silver Jubilee Session of the Science Congress (1938) held at Calcutta and dealt with much the same aspects of diastrophism and evolution embodied in the present symposium. It is interesting to note, in the present context, the following observation made by one of the speakers at the Calcutta discussion: 'The syntheses of the so-called geological philosophers, with their cycles and epicycles of diastrophism and their rhythmic orogenies are foredoomed when extended beyond provincial developments in an attempted worldwide application'.

It is in the study of the evolutionary history of fossil plants that we come across some of the most striking examples of certain periods when there seem to be sudden and abrupt changes in the manner and rate of evolution resulting in a complete 'transformation' in the character of the floras; and there has always been a temptation to correlate such periods with corresponding periods of diastrophism, and establish a relationship of cause and effect.

Prof. Seward in his famous Hooker lecture (1922) referred to this aspect and discussed the deep significance of such 'nodal points' in the history of plant evolution. A couple of years later, Dr. D. H. Scott drew our attention to the four periods of 'transformations' in the evolutionary history of plants and re-discussed the whole problem in the light of Prof. Seward's views. More recently (1937), Prof. Birbal Sahni reverted to this topic again in his address on 'Revolutions in the Plant World' and reviewed the whole position from various points of view, making some very interesting comments and suggestions. He concluded by saying that while the problem of these 'revolutions' still defies solution, one broad fact remains, viz., 'that some of the periods of the most active creation of new forms of life have coincided with the physical revolutions of the geological past'. Dr. and Mrs. Jacob, in their recent article in *Current Science* (1953) have also referred to some aspects of this study, and tried to show a relationship between cyclic geological phenomena and their influence on plant evolution through the ages.

From this general review, it is clear that the question of establishing any kind of intimate relationship between Diastrophism and Evolution—and that, on a worldwide basis—is not so simple as it looks; and the great difficulty is to account for the selective manner in which this relationship has operated at different times and on different groups. The facts of the case are by no means clear or conclusive. 'Evolution' implying the progressive appearance and disappearance of life forms, has obviously been a very complicated process resulting from the action, reaction and interaction, of a variety of factors; and while it is true that the palaeontological record reveals certain periods of abrupt and rapid changes, it would appear that in both the geological and biological fields, such revolutions are merely 'provincial interruptions in an evolutionary continuum'.

ELECTRONMICROSCOPY FOR STUDY OF THE NERVE SYSTEM

IN studying the conducting threads of nerves under a light microscope, the finer fibres are seen to have a jelly-like inner part and a pearly sheath of fatty substance, called myelin, enclosed in thin membrane. This membrane and the fine fissures found in it are all that it has been possible hitherto to discern. By using different reagents it was only just possible to see the outer structure through the light microscope, the earliest signs of which are extremely thin

fibriles, the so-called neuro-fibriles, in the inner part of the nerve thread.

However, using the electron microscope, Prof. H. Fernandez-Moran, of the Karolinska Institute, has observed the fine structure of the inside of the thread and has shown that the myelin sheath consists of over 100 layers, each only about 80-100 Å thick. These layers are as thin as those discovered by F. Sjöstrand in his pioneer examination of the structure of the eye's retina, and later in the peripheral nerve.

ON THE EXCHANGE MECHANISM IN BONE

T. K. WADHWANI

Indian Institute of Science

BASED on their phosphate exchange reactions *in vivo*,¹⁻⁵ the calcified tissues have been regarded⁵ as composed, physiologically at least, of two parts; the one, that rapidly comes to equilibrium with the blood minerals, and changes its composition in conformity with the mineral composition of the blood, has been designated as labile, and the other, which is relatively much less affected by the composition of the blood, has been designated as stable or non-labile. Though no experimental proof so far has been produced to support this theoretical division of the calcified tissues into labile and non-labile parts, the exchange reactions, which the calcified tissues, more particularly the bones, enter with the mineral constituents of the blood, have, nevertheless, been sought to be explained on the basis of this hypothesis. Recently, it has been shown^{6,7} that bone salt also exhibits similar exchange reactions *in vitro*. When bone salt is equilibrated with a solution of NaF, it is observed that fluoride is removed by the bone salt, and that the corresponding quantity of the anions like $\text{CO}_3^{=}$ and $\text{PO}_4^{=}$ is released from the bone salt into the liquid phase in the manner of Freundlich adsorption isotherm. It was thought that the anions of the bone salt that are thus exchanged with the fluoride of the liquid phase, which gets adsorbed, are probably likewise already adsorbed on the bone salt, and constitute what has been termed as its labile part, and that by repeatedly equilibrating a given quantity of bone salt with a solution of NaF, and determining the quantity of the fluoride adsorbed, and the quantities of the anions of the bone salt liberated into the liquid phase, it should be possible to determine the relative quantities of labile and non-labile fractions in a given quantity of bone salt, and thus experimentally substantiate the above hypothesis. Based on these observations and arguments, an attempt has been made to determine the amounts of labile and non-labile parts of bone salt. A sample of bone salt (percentage composition: N = 4.97, Ca = 26.42, P = 12.72, Mg = 0.47, Na = 0.36, F = 0.073, $\text{CO}_3 = 4.25$, Residual Ca = 23.59, Ratio Residual Ca : P = 1.85), weighing 1.002 g., was equilibrated with a solution (2.5 per cent.) of NaF. At equilibrium, the quantity of fluoride adsorbed, and the corresponding quantities of $\text{CO}_3^{=}$, and $\text{PO}_4^{=}$, released from the solid phase into the liquid phase,

were determined. As the replacement of adsorbed anions of bone salt, and their consequent release into the liquid phase, when a sample of bone salt is equilibrated with a solution of NaF, is determined by the concentration of fluoride in the liquid phase, and as the concentration of NaF in the liquid phase cannot be raised beyond 4 per cent., that being approximately the solubility of NaF in water, and as the quantity of adsorbed anions released into the liquid phase with a 4 per cent. solution of NaF may either be the total quantity of adsorbed anions in a given quantity of bone salt or a part thereof, the same bone sample, after its quantitative separation from the liquid phase, was again equilibrated with a fresh aliquot of NaF solution. This process of repeated equilibration was continued till the liquid phase at equilibrium was not found to contain phosphate or carbonate. The process of equilibration of the above quantity of the bone salt with a solution of NaF was carried out 12 times. In the twelfth equilibration study, it was observed that the liquid phase at equilibrium contained no carbonate, about 0.3 mg. of P (per 50 c.c. of the solution), and had the fluoride concentration little higher than that of the original solution, indicating that the capacity of the above quantity of the bone salt to enter into exchange reactions had been reached, and that the further quantity of fluoride was not only not being adsorbed but that part of the previously adsorbed fluoride was being released back into the liquid phase. At this stage, the bone salt was quantitatively collected and analysed, and was found to contain a trace of carbonate, 10.12 mg. of P, and 233.7 mg. of F, as against the initial values of 43.43 mg. of CO_3 , 130.0 mg. of P, and 0.7459 mg. of F. Thus, it can be seen that about 94 per cent. of the anions in the above quantity of bone salt, by the process of repeated equilibration with a solution of NaF, has been replaced by fluoride in the manner of Freundlich adsorption isotherm, and that it has not been found possible to replace likewise the remaining percentage of anions with fluoride. Can it now be assumed that the remaining percentage of anions represents that part of the bone salt, which has been termed non-labile and real, and that the considerably large percentage of anions, that have been replaced with fluoride, represents that part of the bone salt, which has been designated as

labile or adsorbed? Before answering this question, it is desirable to consider the theoretical possibility of the replacement with fluoride of the remaining percentage of anions in the bone salt. There does not seem to be any reason as to why it cannot be assumed that it is possible to replace, in the manner of Freundlich adsorption isotherm, the remaining percentage of anions in the bone salt with fluoride, provided, fluoride, under such conditions, is adsorbed by the bone salt. It can be seen from the data presented that, in the twelfth equilibration study, the liquid phase contained no carbonate, about 0.3 mg. of P per 50 c.c. of the solution, and had the fluoride concentration little higher than that of the original solution, indicating that further quantity of fluoride was not only not being adsorbed but that part of the previously adsorbed fluoride was being released back into the liquid phase. As fluoride was not being adsorbed, the remaining anions were not being replaced with it, and consequently were not being released into the liquid phase. Such a circumstance, however, can be viewed differently also. Further quantities of fluoride were not being adsorbed by the bone salt, because there were no replaceable anions left in it. In that case, the remaining percentage of anions will have to be regarded as that fraction of the bone salt, which has been designated as non-labile and real, and the rest of

bone salt, as labile and adsorbed. However, it does not seem to stand to reason to assume that so large a fraction as 92 per cent. of the total P in the bone salt is adsorbed on the remaining 8 per cent. Under such circumstances, the only other alternative has to be accepted that all the anions in the bone salt, at least theoretically, can be replaced with fluoride by the process of repeated equilibration, and in the manner of Freundlich adsorption isotherm. Thus, the theoretical division of bone salt, on the basis of its exchange reactions *in vivo*, into labile and non-labile parts, has not been found to be correct *in vitro*. It seems to be the fundamental property of the bone salt to enter into exchange reactions with the anions of the liquid phase in the manner that can approximately be denoted by the Freundlich adsorption isotherm. Such a property of the bone salt may be the basis of the exchange mechanism in bone *in vivo*.

The author wishes to thank Prof. K. V. Giri for his keen interest in the work.

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4. Hevesy and Armstrong, *Ibid.*, 1940, **133**, p. xlv.
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7. —, *Communicated to the Ind. Chem. Soc.*

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

THE European Organization for Nuclear Research has emerged from its planning phase and will shortly become a reality under the terms of a Convention signed recently in Paris by representatives of twelve nations.

The programme for the new European Organization includes the construction of a new international laboratory for nuclear research, and the continuation of co-operation between existing laboratories in the various countries.

The construction of the laboratory and its equipment is expected to require seven years. The cost of all activities during those seven years will total 120 million Swiss francs, including construction of the laboratory and its equipment. This will consist mainly of two large

accelerators, a synchro-cyclotron, which will probably be completed in four years, and a proton synchrotron that will take seven years to construct.

When the Convention becomes effective, it is planned to build the laboratory near the French border three miles north-west of Geneva.

The research will be fundamentally scientific and of non-military character. None of the work will be secret. The laboratory will not include an atomic reactor and will not be used for the production of high-energy materials. It will be used only to study the properties of atomic nuclei, and of such elementary particles as protons, neutrons and mesons.

RADIO ENGINEERING*

HARDLY any book on the fundamentals of radio met with such diverging criticism as the "Sandeman", when it first appeared in 1949. Completely enthusiastic reviews on the one side and condemnation of many aspects of the book on the other side† seem to indicate the need for an individual approach and a subjective evaluation of the merits of the book. The fact that a second edition is to follow the first within a short period of four years gives the best answer to the controversy in the learned journals. Many readers apparently found very valuable information in the book, for which they might have searched in vain at other places. Indeed the book is an unconventional one in many aspects. Written by one thoroughly familiar with the technical problems of one of the world's biggest broadcasting systems (B.B.C.) we may expect to find a lot of reference to the specific techniques and practices obtaining in such laboratories and also details about their installation. Transmitters naturally will get preference to receivers. Practical hints are widely spread over the two volumes and emphasis is given to methods of measurement needed preferably in radio broadcasting systems. Many reviewers deprecated this undoubted bias of the book, others stressed the importance of publishing such material in book form.

In the second volume the author tries to balance this bias for the practical aspect by including 140 pages on network theory and filters. We feel that previous reviews did not do full justice to the excellent presentation of the so-called German method of network analysis and synthesis. The full-scale reproduction of matrix-tables for four-poles from the German journal "Elektrische Nachrichtentechnik" will help English readers to familiarise themselves with this important tool of network theory. The chapter on filters constitutes a welcome deviation from conventional text-books by stressing the practical side of filter design. It is regretted, however, that the second edition does not refer to the component design and to the actual layout of commercial filters. Considering the above-

mentioned bias of the book, one ought to expect in it such important aspects as the design of maximum Q coils, the selection of best suited capacitors for filters or the influence of magnetic stray-coupling on the characteristics of medium frequency filters. Instead, we find in the new edition a 30-page chapter on transmission line filters with many design charts which will be welcomed by the readers.

Some of the other chapters have been improved for the new edition, but not largely changed. They relate to balanced and unbalanced circuits, interference and noise, measuring equipment, equalizer design, audio expansion and compression and finally feed-back. The 50-page chapter on receivers has generally been considered too short, compared with the rest of the book and suggestions had been made by previous reviewers, to omit it as a whole and call the book "Broadcasting" or "Transmitting" technique. The author, however, has kept the chapter untouched for the second edition. Even apparent mistakes as the one on pages 87 to 89 (where Fig. 1 refers to a delayed a.v.c. circuit having a delay voltage across R_1 , whereas the text describes the circuit as one of undelayed character, stating at the top of page 89 that "delay voltage has to be inserted in series with the diode in Fig. 1") have not been corrected. Likewise, the bibliography at the end of the book is very incomplete and misleading. There is not a single reference to articles after 1949 and only a few references to those since 1940, so that the bibliography is now much out-of-date for a second edition.

R. FILIPOWSKY.

* *Radio Engineering*, Vol. 2. By E. K. Sandeman, 2nd Revised Edition, 1953. 613 pp. 55 sh. Chapman & Hall, Ltd., London.

† Compare some of the reviews to the first edition: *Wireless Engineer*, December 1949, **26**, 412-13; *Electronic Engineering*, June 1950, **22**, 252-53; *Journal of Sci. Instruments*, April 1950, **27**, p. 112; *J. Franklin, Inst.*, 1949, p. 267; *Toute la Radio* (Paris), Oct. 1949 (No. 139), p. 272.

NON-FERROUS METAL INDUSTRY IN INDIA

A SYMPOSIUM on Non-Ferrous Metal Industry in India is to be held at the National Metallurgical Laboratory, Jamshedpur, in January 1954. Topics to be discussed will include extraction and refining of non-ferrous metals, melting and foundry techniques, and economics of Indian non-ferrous metal industry. Those

wishing to present papers may please forward an advance copy of their papers to the organisers before 15th November 1953, so that the final programme, abstracts of the papers, etc., may be drawn up and circulated. Equipment for the projection of slides and drawings will be available.

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ACHROMATIC CONDITION FOR A COMBINATION OF TWO LENSES KEPT AT A DISTANCE

THE treatment here follows that of Moffitt¹ for two lenses in contact.

The focal length of a combination of two lenses separated by a distance d is given by

$$1/F = A(\mu - 1) + A'(\mu' - 1) + AA'd(\mu - 1)(\mu' - 1) \quad (1)$$

where μ and μ' are the refractive indices of the materials of the two lenses.

$A = \{(1/r_1) - (1/r_2)\}$ and $A' = \{(1/r_1') - (1/r_2')\}$, r_1, r_2, r_1' and r_2' being the radii of curvature of the surfaces of the two lenses.

Putting $dF/d\lambda = 0$ we get the following condition for complete achromatism

$$A(d\mu/d\lambda) + A'(d\mu'/d\lambda) + AA'd\{(\mu - 1)(d\mu'/d\lambda) + (\mu' - 1)(d\mu/d\lambda)\} = 0 \quad (2)$$

Using the simple Hartmann dispersion formula, which holds empirically in the visible region of the spectrum,

$$\mu = \mu_0 + c/(\lambda - \lambda_0)^a \text{ and } \mu' = \mu'_0 + c'/(\lambda - \lambda'_0)^{a'} \quad (3)$$

and substituting (3) in (2) we get

$$C_1(\lambda - \lambda_0)^{a'+1} + C_2(\lambda - \lambda_0)^{a+1} + C_3\{a'(\lambda - \lambda_0) + a(\lambda - \lambda'_0)\} = 0 \quad (4)$$

where

$$C_1 = Aca\{1 + A'd(\mu'_0 - 1)\} \quad (5A)$$

$$C_2 = A'c'a\{1 + Ad(\mu_0 - 1)\} \quad (5B)$$

$$C_3 = AA'cc'd \quad (5C)$$

(i) If a and a' are non-integral, one can write $(\lambda - \lambda_0)^{a+1}$ and $(\lambda - \lambda'_0)^{a'+1}$ as a power series in λ or $1/\lambda$. Equating the coefficients of like powers of λ or $1/\lambda$, one first gets $C_1 + C_2 = 0$, $\lambda_0 = \lambda'_0$ and $a = a'$, making the first two terms in (4) cancel each other. Thus

$C_3 = 0$ and $d = 0$, so that the only possible solution is that of two lenses in contact.

(ii) If $a = 1$ and a' is non-integral, we get complete achromatism only when $C_1 = 0$ and $C_2 = 0$. This gives infinite focal lengths for the lenses and is of no use.

(iii) If $a = a' = 1$, as is the case for most of the optical materials, then, equating to zero the coefficients of λ^2 and λ and the constant term in (4), we get

$$C_1 + C_2 = 0 \quad (7A)$$

$$C_3 - \lambda_0' C_1 - \lambda_0 C_2 = 0 \quad (7B)$$

$$C_1 \lambda_0'^2 + C_2 \lambda_0^2 - C_3 (\lambda_0 + \lambda_0') = 0 \quad (7C)$$

(7C) can be derived from (7A) and (7B). Hence we need consider only (7A) and (7B), which give

$$(1/d) = A[\mu_0 + \{c/(\lambda_0' - \lambda_0)\} - 1] \\ = A'[\mu_0' + \{c'/(\lambda_0 - \lambda_0')\} - 1] \quad (8)$$

For a particular value of either A , A' or d , the condition can be realized by a suitable choice of the optical material of the two lenses. (8) can also be expressed as

$$d = f(\lambda_0') = f'(\lambda_0) \quad (9)$$

where $f(\lambda_0')$ and $f'(\lambda_0)$ are the focal lengths of the two lenses for the wave-lengths λ_0' and λ_0 respectively.

The constant focal length of the perfectly achromatic combination is given by

$$1/F = A(\mu_0 - 1) + A'(\mu_0' - 1) + AA'd(\mu_0 - 1)(\mu_0' - 1) \quad (10)$$

the other terms vanishing under condition (7) from which (8) and (9) have been derived.

The authors acknowledge grateful thanks to Dr. K. Majumdar, Dr. G. B. Deodhar, Dr. D. Sharma, Prof. B. K. Agrawal and Dr. Y. P. Varshni for their interest in the investigation.

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1. (a) Moffitt, *Phys. Rev.*, 1917, 11, 144.

REUTILIZATION OF MAC CONKEY'S BROTH FOR *B. COLI* PRESUMPTIVE TEST

It is found that MacConkey's bile salt-neutral red lactose broth,¹ giving negative results for *B. coli* presumptive test, on incubation for 48 hours at 37° C. after inoculation with treated water sample, can be reused for the same test on the basis of the following procedure.

(a) Test-bottles showing total absence of lactose fermenters, are first sterilized by steaming

for 10-15 minutes as it is found that though the medium shows negative results, still non-lactose fermenters are sometimes present in the medium. It is also found that pH of this used medium remains practically same even after inoculation and incubation. (b) Each test-bottle containing 50 ml. of the broth (triple strength) is inoculated with 100 ml. of the water sample. Thus when all the test-bottles (showing negative results) are pooled together, the bulk forms the single strength medium. (c) This medium can directly be used for filling 1 ml. test-tubes (after adjusting the pH externally to 7.6 if reduced). In order to restore the triple strength to this medium, all the usual ingredients¹ (except water and neutral red) are now added in double strength. (d) The medium is autoclaved at this stage at 10 lb. pressure for 10-15 minutes. (e) It is then filtered, pH adjusted externally to 7.6, using bromothymol blue as external indicator. Then for every 100 ml. of this medium 2.0-2.5 ml. of 1 per cent. Neutral red solution is added. (f) The medium is filled up in test-tubes and bottles and sterilized by steaming for 10-15 minutes and used.

The results obtained with the renewed medium compared very well with those of MacConkey's original broth, in case of some 200 samples, and the comparison shows satisfactory results as shown in Table I.

TABLE I

Number of samples showing
Lactose Fermenters @ 37° C.
after 48 hours (positive
in minimum quantity

| 0-01 ml. | 0.1 ml. | 1 ml. | 10 ml. | 0 in 10 ml. | 100 ml. | 0 in 100 ml. |
|----------|---------|-------|--------|-------------|---------|--------------|
|----------|---------|-------|--------|-------------|---------|--------------|

I. No. of samples tested by Renewed medium as shown above

| | | | | | | |
|-----------------------|----|----|----|----|----|----|
| 68 Raw waters | 3 | 39 | 16 | .. | .. | .. |
| 51 Settled waters | .. | 6 | 31 | 15 | .. | .. |
| 32 Filtered waters | .. | 1 | 4 | 24 | 3 | .. |
| 49 Chlorinated waters | .. | .. | .. | 1 | .. | 3 |

II. No. of samples tested by MacConkey's original broth

| | | | | | | |
|-----------------------|----|----|----|----|----|----|
| 68 Raw waters | 3 | 41 | 14 | .. | .. | .. |
| 51 Settled waters | .. | 6 | 31 | 15 | .. | .. |
| 32 Filtered waters | .. | .. | 5 | 24 | 3 | .. |
| 49 Chlorinated waters | .. | .. | .. | 1 | .. | 3 |

Further, to maintain the nitrogen value at any particular level with reference to the growth

of lactose fermenters, nitrogen was determined before and after inoculation and at various stages of lactose-fermentation in the original as well as renovated broth.

It was found that approximately 50 per cent. of the nitrogen is utilised in full lactose-fermentation (for acid and gas) and 50 per cent. still remains intact in the medium. Also approximately 6 to 8 per cent. nitrogen loss occurs in the medium which gives negative results (i.e., showing absence of lactose-fermenters); perhaps non-lactose-fermenters utilise this little amount of nitrogen. However, there still remains enough nitrogen balance to permit growth of lactose-fermenters.

This renewed medium has proved to be as specific for the growth of *B. coli* group of organisms as the original medium. All the six members of the *B. coli* type of organisms have been isolated from the renewed medium showing presence of lactose fermenters. Also the traces of available free chlorine introduced in the medium along with the water sample have no inhibitory effect as is clear from the results given in the Table I.

It is suggested, however, that this renovation may be limited to 2-3 times successively. After that fresh MacConkey's broth may be used, reutilized for 2-3 times and thrown off.

Public Health Laboratory, D. T. HARIKISHIN.
Govt. of Bombay, Poona-1,
January 1953.

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INFLUENCE OF ENVIRONMENTAL TEMPERATURE ON THE DIETARY PRODUCTION OF FATTY LIVERS

Of the various factors involved in the dietary production of fatty livers, the role of the environmental temperature is probably the least studied. It was noticed by us that the extent of fatty infiltration of the liver (as evidenced by measurement of liver fat content) produced in animals at different times of the year varied considerably, though in all cases, the same basal dietary regimen was employed. At first these results were inexplicable, but a closer study showed that under the same dietary conditions, the fatty infiltration produced in animals during summer was higher than that produced in winter.

In experiments conducted during November and December on the production of fatty livers in rats by dietary means on a 10 per cent. casein

30 per cent. lard diet, an average liver fat value of 0.52 g. per 100 g. body weight was obtained. On the same basal diet, in experiments conducted during the months of March, April and May, the hottest time of the year, a mean liver fat value of 1.04 g. per 100 g. body weight was obtained. Similarly on a 5 per cent. casein 40 per cent. lard diet, the values for liver fat obtained were 1.13 g. in February and 1.50 g. in April. The differences between the mean temperatures in May and December in Bombay do not ordinarily exceed 10° F., but there seems to be higher variation between the maximum and minimum temperatures in December (about 23° F.) than in May (about 13° F.).

These findings are in accordance with the results of Sellers and You,¹ who have found a very much lower level of fat (7.2 ± 1.24 per cent.) in the livers of rats fed *ad libitum* on a diet deficient in choline and its precursors when the rats were kept at a temperature of 2.5° C. than (24.8 ± 4.9 per cent.) when kept at room temperature of $25 \pm 2^\circ$ C. The same authors reported in a recent paper² that when a hypolipotropic diet of moderate fat content (20 per cent.) is fed to rats exposed to a temperature of $1.5 \pm 1^\circ$ C., excessive deposition of fat in the liver is prevented. The comparative inefficiency of fat in the production of fatty livers at lower temperatures may be due to (1) greater utilization of fat at low temperatures, to satisfy the calorie requirements so that less of the fat is available for fatty infiltration or (2) higher requirements for many of the B vitamins, especially choline^{3,4,5} at higher temperatures, thus putting a greater demand for choline on hypolipotropic diets and bringing about a more acute deficiency of the vitamin. It is to be mentioned, however, that there was a difference in temperature of 20° C. in the experiments of Sellers and You, but they get a percentage liver fat difference of more than 15 per cent.; whereas in our experiments for a difference of temperature of, say 6° C. approximately, the differences in liver fat percentages do not exceed 4.7 per cent. on a 10 per cent. casein diet and 2.5 per cent. on a 5 per cent. casein diet. The detailed account will be published elsewhere.

Haffkine Institute, K. K. GOVINDAN,
Bombay, M. V. RADHAKRISHNA RAO.
February 24, 1953.

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AMINO ACIDS IN SEWAGE AND
ACTIVATED SLUDGE

VERY little is known of the amino acid composition and the nature of other compounds present in sewage and sludges.¹⁻⁴ Employing the recently developed method of circular paper chromatography,⁵⁻⁷ we have made some observations on the amino acids in raw sewage and activated sludge.

Representative samples of raw sewage, activated sludge and the purified effluent were collected over a period of 5 weeks, and the dried materials (dried at 60° C.) were employed for the studies. The nitrogen contents of the materials were (% N): raw sewage, 3.82; activated sludge, 7.39; and the purified effluent, 0.15. The results of chromatographic analysis of these materials are given in Table I. In the purified effluent no amino acid could be detected in the free or combined form.

TABLE I

Amino acids in raw sewage and in activated sludge
(Expressed as mg. per g.)

| Amino acids | Raw sewage | | Activated sludge | |
|-------------------------------------|------------------|-------------------------|------------------|-------------------------|
| | in the free form | in the acid hydrolysate | in the free form | in the acid hydrolysate |
| 1 Cystine | Present | 9.6 | Nil | 19.0 |
| 2 Lysine and histidine | Present | 13.3 | 0.5 | 48.0 |
| 3 Arginine | Present* | 8.7 | 0.3 | 26.5 |
| 4 Serine, glycine and aspartic acid | Present* | 26.5 | 0.8 | 51.5 |
| 5 Glutamic acid and threonine | Present* | 34.5 | 1.0 | 69.0 |
| 6 Alanine | Absent | 14.6 | 1.1 | 33.5 |
| 7 Proline | Absent | † | Nil | † |
| 8 Tyrosine | Present | 7.9 | 0.6 | 18.7 |
| 9 Tryptophane | Absent | ‡ | 0.7 | ‡ |
| 10 Methionine and valine | Present* | 10.1 | 1.0 | 26.5 |
| 11 Phenylalanine | Present | 9.4 | 0.6 | 17.6 |
| 12 Leucines | Present* | 16.4 | 1.5 | 38.9 |

* Present in slightly higher concentrations than in the other cases but not in estimable amounts.

† Present but was not estimated.

‡ Tryptophane, if present, should have been destroyed during acid hydrolysis.

Rows 2, 4, 5, 10 and 12 give the values for the groups of amino acids as these appear in groups on the chromatogram when developed with *n*-butanol-acetic acid-water as the solvent. The values were obtained by comparing the colour intensities with those obtained by using a mixture of known amounts of the correspond-

ing amino acids in equal proportions. Lysine, histidine, serine, glycine, aspartic acid, glutamic acid and threonine were identified individually by running two-dimensional sheet chromatograms,⁸ which were developed in one direction with phenol saturated with water in an atmosphere of coal gas, and in the other direction with *n*-butanol-acetic acid-water. Methionine was identified by using platinum-iodide reagent, and valine in the methionine-valine band was identified by oxidation of methionine using hydrogen peroxide.⁹

The values for tyrosine in the acid hydrolysate are not corrected for its lower solubility in slightly acid pH range.

The above observations show that (1) raw sewage contains almost all the essential amino acids, (2) during purification by the activated sludge process, the amino acids are concentrated in the sludge, and (3) the purified effluent is practically free from amino acids.

We wish to thank Dr. K. V. Giri for his keen interest in the work.

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March 4, 1953. A. V. S. PRABHAKARA RAO.

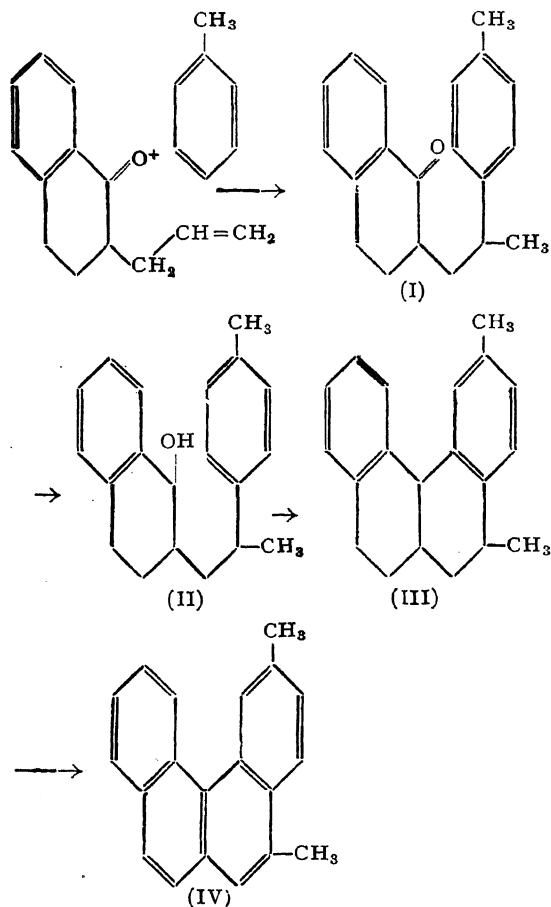
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SYNTHESIS OF 2:3'-DIMETHYL-3:4-BENZPHENANTHRENE

SINCE the discovery by Cook and his associates¹ that 3:4-benzphenanthrene is a potent carcinogen, much interest has been displayed in this field and a number of synthetic routes to its derivatives have been worked out. One such method was developed by Mukherji and Rao² when they synthesised 2-methyl-3:4-benzphenanthrene. By an extension of this method we have now synthesised 2:3'-dimethyl-3:4-benzphenanthrene.

2-Allyl-1-tetralone² was subjected to aluminium chloride-catalysed reaction^{2,3} with toluene

when 2-[β -methyl- β -(*p*-tolyl)-ethyl]-1-tetralone (I), b.p. 240°/13-14 mm., was obtained in satisfactory yield. Reduction of the above tetralone was effected with aluminium isopropoxide to afford almost a quantitative yield of the corresponding carbinol (II), b.p. 180-82°/1 mm. This carbinol was then cyclised with concentrated sulphuric acid⁴ to give 2:3'-dimethyl-1:2:9:10:11:12-hexahydro-3:4-benzphenanthrene (III), b.p. 180-85°/3-4 mm. Dehydrogenation of this hexahydro derivative with palladium charcoal (30 per cent.) at 300-20° for 4 hours proceeded smoothly to give 2:3'-dimethyl-3:4-benzphenanthrene, b.p. 190-95°/2 mm., as a pale yellow viscous oil, which did not solidify. However, this hydrocarbon gave a deep orange picrate which was crystallised from ethanol, m.p. 146°.



The proof of the *para*-orientation in the Friedel-Crafts product was obtained through alkaline permanganate oxidation of I to a mixture of phthalic and terephthalic acids which were separated by fractional crystallisation from

water. Terephthalic acid was identified as its dimethyl ester, m.p. 140°.

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May 4, 1953.

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S. M. MUKHERJI.

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POLYFRUCTOSAN FROM *FURCRAEA GIGANTEA* VENT.

It was previously suggested¹ that the qualitative make-up of the water-soluble carbohydrates present in *Agave vera cruz*² might be common to the *Agave* species in general. This suggestion has gained support from the fact that working with the stem juice of *Furcraea gigantea* (Amaryllidæ),³ we have since obtained for the carbohydrates therein a chromatographic pattern⁴ identical with that from *A. vera cruz*.² Further, characteristics of the polyfructosan isolated from *F. gigantea*, to be described here, are similar to those described for the polyfructosan¹ from *A. vera cruz*.

The stem juice of *F. gigantea*, of the numbers examined, had low optical rotation (from +0.35° to -0.97°), but, as with *A. vera cruz*, became highly levorotatory on mild acid hydrolysis. In common with *A. vera cruz*, the stem juice of *F. gigantea* was also found to be rich in calcium salts.

In contrast to the stem, it was observed that the juice from the bulbels of the plant was much more levorotatory, suggestive of a higher concentration of the polyfructosan therein. So bulbels were chosen for isolating the polyfructosan.

The method of isolation was essentially the same as previously adopted by us for *A. vera cruz*.¹ The bulbels of *F. gigantea* were crushed in an electrical mincer. The juice from the crushed mass was pressed by hand through cloth, heat-coagulated, centrifuged and the green, fibrous residue discarded. To the clear juice thus obtained, ethyl alcohol was added to 60 per cent. concentration (*v/v*). The white, heavy and rather granular precipitate obtained at this stage was removed by centrifuging. To the clear, supernatant solution, a further quantity of alcohol was added to raise its concentration to 80 per cent. in the final solution.

Now a light brown precipitate appeared, which, after separation by centrifuging, was given a wash with 80 per cent. alcohol, dissolved in minimum amount of water and reprecipitated with alcohol by dropwise addition. The precipitate was freed from alcohol under vacuum and finally dried at 110° to remove traces of alcohol, when the material puffed and crumbled to a coarse, almost white powder.

The polyfructosan had the following characteristics:

$[\alpha]_D^{25^\circ} = -37.5^\circ$, $[\alpha]_D^{25^\circ} = -80.2^\circ$, after hydrolysis.

On acetylation with acetic anhydride in pyridine⁵ followed by deacetylation with sodium methoxide in methanol,⁶ a material with $[\alpha]_D^{25^\circ} -40.0^\circ$ was obtained which on hydrolysis gave $[\alpha]_D^{25^\circ} -86.2^\circ$ (corresponding to that of fructose, allowing for temperature and concentration).

The osazone formed from the hydrolysate of the polyfructosan had a crystal pattern typical of fructosazone, and melted at 204° .

Our thanks are due to Dr. Girdhari Lal for his keen interest in the work and to the Economic Botanist to the Government of Madras for identifying the plant for us.

Central Food Tech. Res. Inst., I. S. BHATIA.
Mysore, May 5, 1953. M. SRINIVASAN.

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FORMATION OF MOLYBDENYL FERROCYANIDE COMPLEX

IN the present work, conductometric titrations were carried out between sodium molybdate (14.68 g./litre) and potassium ferrocyanide (46.658 g./litre) solutions to ascertain the possibility of complex formation between molybdate and ferrocyanide.¹⁻⁴

Samples of G. R. quality were used throughout the work. Measurements of conductivity were made using a dip-type cell to minimise the error due to volume effect and the temperature was $33^\circ \text{C.} \pm 0.2$. Direct and reverse

titrations were done using sodium molybdate and potassium ferrocyanide as titrants respectively, and at different conditions. Results (one set) are shown graphically in Fig. 1. Curve (A)

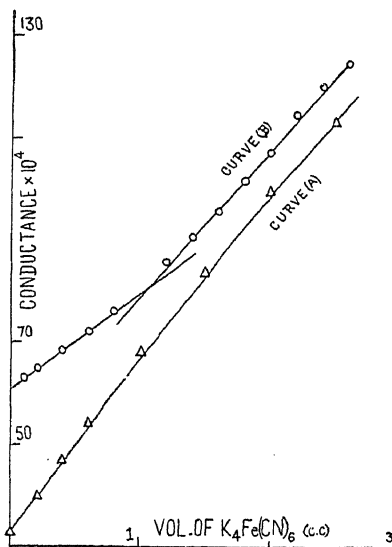
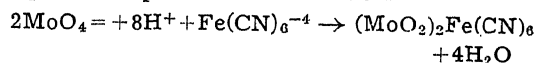


FIG. 1

represents the change in conductance when potassium ferrocyanide solution was added to sodium molybdate solution and this is almost a straight line indicating no complex formation. The pH of the sodium molybdate solution used was 8.2. Next, titrations were carried out starting with sodium molybdate solution at different pH values (obtained by adding different volumes of HCl). The addition of potassium ferrocyanide solution to 200 mol. of sodium molybdate solution containing 0.0587 g. of $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ and HCl to keep the initial pH of the solution at 2.96, is represented by the curve (B). This shows a break corresponding to the addition of 1.1 ml. of potassium ferrocyanide solution. This, on calculation, corresponds to an addition of 2 mol. of $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ to 1 mol. of $\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$. The following equation represents the reaction.



This explains why the complex formation does not take place at higher pH values. According to Jander,⁵ at all pH values higher than the iso-electric point, anionic behaviour of molybdenum is seen. This does not exclude, however, the existence of a certain concentration of cationic molybdenum near about the iso-electric point. Moreover, according to the above equation, hydrogen ions are consumed during the complex

formation and hence the pH should increase more than that warranted by the addition of potassium ferrocyanide solution alone, which is actually found to be so. This, coupled with the formation of the slow-moving complex ion should result in a decrease in conductivity, as observed.

Details will be published elsewhere.

Thanks are due to Dr. S. Pani for his helpful criticism in the work.

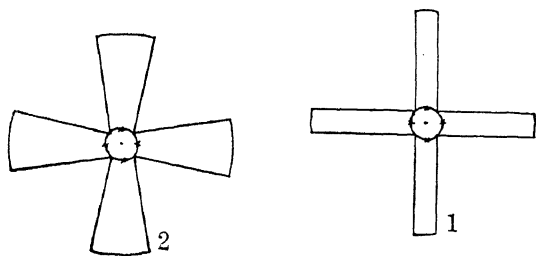
Dept. of Chemistry, D. V. RAMANA RAO.
Ravenshaw College,
Cuttack-3,
May 20, 1953.

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INVESTIGATIONS ON CIRCULAR PAPER CHROMATOGRAPHY

THE R_F values of amino acids¹ and many other substances^{2,3} as determined by circular paper chromatographic technique are higher than those obtained by the unidimensional chromatographic methods. Rao and Giri¹ consider that the movement of amino acids in the former case is directed both in the direction of flow of the solvent towards the edge of the paper and also in the direction orthogonal to the direction of flow of the solvent and hence the movement of amino acids is a two-dimensional movement. The following experiment was designed to test the validity of the assumption.

Out of a filter-paper disc a cross with four equal arms as shown in Fig. 1 is cut out. The



solutions of amino acids are individually applied at the start of each arm on the small circle at the centre. The paper-cross is developed in the same way as in the case of circular technique.⁴ Next, keeping the lengths equal, the arms are made in the form of sectors, gradually widening out from the start at the centre as shown in Fig. 2. The diameter of the inner circle is kept

constant. A number of such paper-crosses are cut out with gradually increasing widths of the four sectors and finally merging into a complete circle. Phenol-water being much less volatile is used as the developing solvent. R_F values so obtained are recorded below:

TABLE I

Developing solvent—Phenol-water; Average distance travelled by the solvent front—6.6 cm.; Radius of the inner circle—1 cm.; Outside radius—7.5 cm.; Initial width of each segment—1.5 cm.

| Amino acids | R_F values | | | | |
|-------------------------------|-----------------------------------|--------------------|---------|-------|----------|
| | Descending Technique ⁵ | Circular Technique | | | |
| Outside width of each segment | | cm. 1.5 | cm. 2.1 | cm. 3 | cm. 10.6 |
| Aspartic acid | .18-.22 | .22 | .27 | .26 | .35 |
| Glycine | .42-.44 | .46 | .45 | .50 | .56 |
| Alanine | .56-.58 | .65 | .68 | .71 | .72 |
| Phenylalanine | .84-.87 | .89 | .88 | .88 | .89 |

TABLE II

Developing solvent—phenol-water; Average distance travelled by the solvent front—7.3 cm.; Radius of the inner circle—0.5 cm.; Outside radius—8 cm.; Initial width of each segment—0.8 cm.

| Amino acids | R_F values | | | | |
|-----------------------------|-----------------------------------|--------------------|---------|---------|---------|
| | Descending Technique ⁵ | Circular Technique | | | |
| Final width of each segment | | cm. 0.8 | cm. 2.5 | cm. 4.2 | cm. 6.3 |
| Glutamic acid | .30-.32 | .33 | .45 | .46 | .47 |
| Serine | .37-.39 | .41 | .51 | .51 | .53 |
| Threonine | .50-.53 | .53 | .62 | .65 | .66 |
| Valine | .76-.78 | .76 | .82 | .83 | .84 |

It is clear from the above that horizontal development of a paper-cross with arms of uniform width is identical with unidimensional development. Spots and not arcs due to the amino acids are formed as in the latter case. The R_F values obtained on such a cross are comparable, as is evident from the table, with those obtained by descending technique. But with gradual widening of the arms, the spots tend to be elongated along the width and form into arcs. The R_F values too, gradually increase and finally merge into the values obtained with circular technique. Discrepancies observed in certain cases are within experimental error.

This signifies without doubt that orthogonal distribution of the solvent is responsible for the

higher R_F values in case of circular technique, as assumed by Rao and Giri.¹ More detailed investigations with the technique of circular paper chromatography are being carried out which will be published elsewhere.

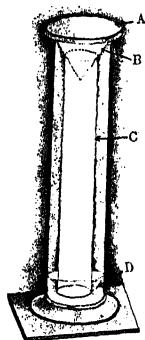
Our sincerest thanks are due to Dr. D. M. Bose and Dr. J. K. Chowdhury, for their kind interest and continued encouragement.

Dept. of Chemistry, H. C. CHAKRABORTY.
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A SIMPLE DEVICE TO KEEP CYLINDERS OF PAPER INSIDE GLASS CYLINDERS FOR PAPER CHROMATOGRAPHY

THE filter-paper on which the material to be chromatographed has been spotted is made into a cylinder by stitching the folded edges with a piece of thread. The diameter of this cylinder will be about $\frac{1}{2}$ – $\frac{3}{4}$ " less and its height about 1" less than that of the glass cylinder. A circular filter-paper is folded into a cone and then placed with the tip of the cone inside the paper cylinder and the rim flush with the top of the glass cylinder. The solvent mixture is placed at the bottom of the glass cylinder and the groundglass cover is then placed on the top of it. Since both the spotted paper



A. Ground glass cover. B. Filter-paper cone.
C. Filter-paper cylinder. D. Solvent mixture.
and the filter-paper cone have a circular cross-section, the paper cylinder is held exactly central leaving a clear annular space between the

glass and paper cylinders (*vide sketch*). As an additional precaution to ensure that the paper cylinder does not touch the sides of the glass cylinder and the annularity between the two cylinders is maintained, a ring made of glass rod or tubing, or a shallow flat dish of the shape of a Petri dish with internal diameter slightly larger than that of the paper cylinder may be placed at the bottom of the glass cylinder. The shallow dish can be made in the laboratory by cutting a beaker or reagent bottle of suitable size.

The device described above is very useful in paper chromatographic work.

Division of Fruit Tech., G. S. SIDDAPPA.
Central Food Tech. Res. Inst., B. S. BHATIA.
Mysore, June 10, 1953.

2:4-DINITRO-6-NITROSO-BENZOIC ACID

SACHS AND EVERDING¹ and later Secareanu² have reported the formation of 2:4-dinitro-6-nitroso-benzoic acid by prolonged exposure of a solution of 2:4:6-trinitro-benzaldehyde in benzene, to sunlight. They have described the material as of yellow brown colour, M.P. 229° (decompn.). The yellow brown solid which we obtained on repetition of the above work, was different from a nitroso-dinitro-benzoic acid as shown by its analysis, equivalent weight and molecular weight.

We have now found that 2:4-dinitro-6-nitroso-benzoic acid separates in the form of beautiful green needles after a short (2 hours) exposure of a saturated solution of 2:4:6-trinitrobenzaldehyde in dry benzene, to sunlight. The pure green-coloured acid melts at 200.5°. It is easily soluble in water (*vide infra*), ethyl alcohol, ether, ethyl acetate, hot benzene and the solutions are green. It is insoluble in carbon tetrachloride. It gives the characteristic reactions of a nitroso compound. (Found: N, 17.4 per cent.; equi. wt. 240; mol. wt. 239; required for $C_7H_3N_3O_7$:—N, 17.43 per cent.; equi. wt. 241; mol. wt. 241.)

On warming with water 2:4-dinitro-6-nitroso-benzoic acid has been found to condense rapidly to 2:2'-dicarboxy-3:3'-5:5'-tetranitro azoxybenzene, M.P. 245° (decompn.), whose structure was confirmed by analysis. (Found:—N, 18.1 per cent.; equi. wt. 230.2; $C_{14}H_6N_6O_{13}$ requires N, 18.03 per cent.; equi. wt. 233) and by decarboxylation to the known³ 3:3'-5:5'-tetranitro-azoxybenzene.

2:2'-dicarboxy-3:3'-5:5'-tetranitroazoxybenzene was further found to be identical

(analysis, mixed m.p. and infra-red spectrum) with the 'white compound' which is a byproduct of continuous T.N.T. manufacture, and whose constitution was so far not established. A tricyclic structure—Tetranitro-dicarboxy-phenazine-N-oxide has been proposed for the white compound.⁴ That the white compound has an azoxy structure is now conclusively proved from the following evidence:—

(i) The white compound is formed from 2:4-dinitro-6-nitroso-benzoic acid by elimination of oxygen. The tricyclic structure based on phenazine N-oxide would require elimination of a water molecule.

(ii) The composition of the white compound, especially its hydrogen content, agrees with that required for an azoxy compound (Found H, 1.31 per cent.; required for $C_{14}H_6N_6O_{13}$, 1.29 per cent.; for $C_{14}H_4N_6O_{13}$, 0.86 per cent.).

(iii) The infra-red spectrum of the white compound does not show the presence of a tricyclic structure.

(iv) Formation of azoxy compounds through intermediate nitroso compounds in photodecomposition of aromatic Nitro-aldehydes is known.^{5,6}

(v) The decarboxylated 'white compound' is identical with 3:3'-5:5'-tetranitroazoxybenzene prepared directly from trinitrobenzene.³

The yellow brown substance obtained according to Sachs and Everding's¹ or Secareanu's² procedure was also found to be crude 2:2'-dicarboxy-3:3'-5:5'-tetranitroazoxybenzene. Smooth condensation to azoxy compounds appears to be a general reaction of ortho-nitroso benzoic acids. 2:2'-dicarboxy-5:5'-dinitroazoxybenzene has similarly been obtained from 2-nitroso-4-nitrobenzoic acid.

Incidentally, it has been found that an azoxy group requires only four equivalents of titanous chloride for reduction instead of the expected six. This indicates that the -N=N- linkage is reduced prior to the N→O linkage and the intermediate hydroxylamine rearranges to the *para*-amino-phenol, in the acid-reducing medium.

Thanks are due to Shri B. B. Chaudhuri, S.D.M.E., for his interest and encouragement, and to the Director of Technical Development, M.G.O. Branch, Army Headquarters, New Delhi, for permission to publish the results.

Technical Development S. A. JOSHI.
Establishment, W. D. PATWARDHAN.
Military Explosives,
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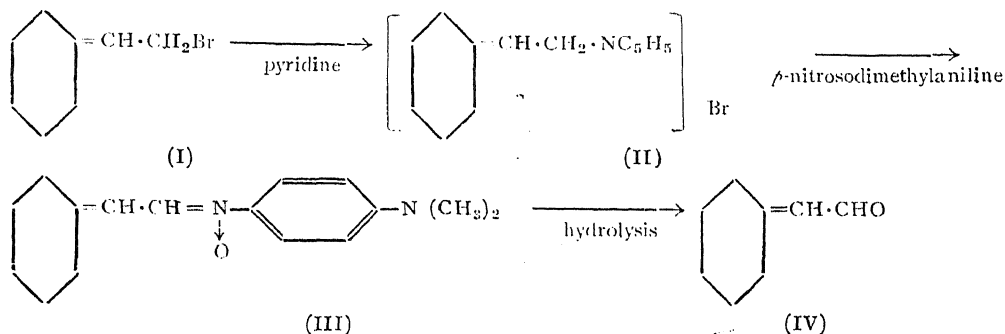
SYNTHESIS OF CYCLOHEXYLIDENE ACETALDEHYDE BY KRÖHNKE'S METHOD

KRÖHNKE¹ has described a reaction by which halogen compounds of the formula $RCOCH_2X$ and $RHC=CH.CH_2X$ have been converted to the corresponding aldehyde $RCOCHO$, $RHC=CHCHO$. The reaction consists in the addition of the halogen compound to pyridine, transformation of the pyridinium salt with *p*-nitrosodimethyl aniline to a nitrone and hydrolysis of the latter with acid.

This elegant method was successfully employed for the synthesis of phytenal, farnesal, 3, 7, 11-trimethyl-dodecæn-(2)al(1)² and of 3-acetoxy-pregnadien-(5, 17)-al(21) and pregnadien-(4, 17)-one (3)al(21)³. The synthesis of cyclohexylidene acetaldehyde (IV) from β -cyclohexylidene ethyl bromide (I) by Kröhnke's method is reported here.

Cyclohexylidene acetaldehyde has been prepared previously by oxidation of β -cyclohexylidene ethyl alcohol⁴ and also by ozonisation of 1-allyl cyclohexanol and dehydration of the resulting 1-hydroxy cyclohexyl acetaldehyde to a mixture of cyclohexylidene acetaldehyde and cyclohexenyl acetaldehyde.⁵ Rupe⁶ had claimed to have obtained this aldehyde by rearrangement of 1-ethinyl cyclohexanol with formic acid. But later workers^{7,8} proved beyond doubt that the product thus formed was 1-acetyl 1-cyclohexene and not cyclohexylidene acetaldehyde. That cyclohexylidene acetaldehyde also was formed, in traces, along with 1-acetyl-1-cyclohexene during the rearrangement was proved by Chanley.⁸

In the present study, cyclohexanone was condensed with acetylene in liquid ammonia in the presence of sodium acetylide to get 1-ethinyl cyclohexanol. This carbinol was partially hydrogenated over $Pd.CaCO_3$ catalyst to 1-vinyl cyclohexanol which on treatment with PBr_3 gave β -cyclohexylidene ethyl bromide⁴ (I). This unsaturated bromide was converted to the pyridinium compound (II) by treatment with excess of anhydrous pyridine. The pyridinium compound on treating with *p*-nitrosodimethyl aniline gave the corresponding nitrone (III) which on hydrolysis with dilute HCl gave cyclohexylidene acetaldehyde,



characterised by its semicarbazone (m.p. 210° d.) and 2, 4-dinitrophenylhydrazone (m.p. 201-02° d.). The latter derivative has not been reported before. The intermediates (II) and (III) were not isolated in pure form. The yield of the aldehyde was very poor.

Synthesis of methyl-cyclohexylidene acetaldehydes are being attempted on similar lines.

Dept. of Organic Chemistry, M. C. CHACO.
Indian Institute of Science, B. H. IYER,
Bangalore-3, June 22, 1953.

is larger measuring about 600 microns in diameter. In the female there is a gradual increase in the size of the corpus allatum as mating begins and it reaches its maximum size when the female becomes gravid with the abdomen distended with eggs. As it grows, the rounded gland becomes roughly bilobed and then swells up into a circular, somewhat flattened disc-like body. In this stage, it measures about 750 microns in diameter. After oviposition, the corpus allatum shrinks to the original size.

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CORPUS ALLATUM IN *IPHITA LIMBATA* STAL.

THE corpora allata are well known as endocrine organs of insects having important roles in growth, moulting, metabolism and reproduction. A comparative account of the glands is given by Nabert¹ and Cazal² and the physiology of these has been discussed by Wigglesworth,³ Scharrer⁴ and Thomsen.⁵

In *Iphita limbata* Stal. (Pyrrhocoridae : Hemiptera) the corpus allatum is a median, transparent, somewhat flattened, circular body, lying near the anterior extremity of the aorta, behind the hinder edge of the brain and over the gut. In the adult male it is a small, rounded body measuring about, on an average, 450 microns in diameter. In the young female, it

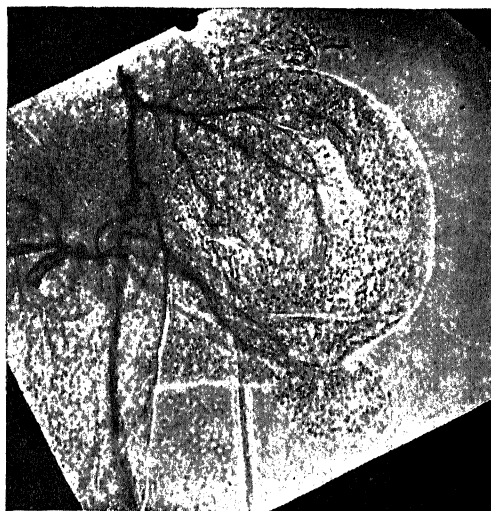


FIG. 1. Live corpus allatum from gravid female of *Iphita limbata* Stal., under the phase contrast microscope —Unstained.

Palm⁶ discusses about the sexual differences in size and structure of the corpus allatum in some insects and points out that in many examples, the gland is larger in the females.

The entire gland under the low power of the microscope shows that it is invested by a thin, membranous envelope which gets easily punctured and appears to be of fibrous nature. It is perfectly transparent under ordinary microscope, but under the phase contrast microscope

it reveals its cellular nature and the copious amount of secretion within as granules (Fig. 1). The gland is supplied by a tracheal trunk which springs from the trachea running posteriorly from the surface of the brain; this tracheal trunk is short and gives rise to a few tracheæ over the surface of the gland. Sections of the corpus allatum (dichromate-formal-acetic fixation followed by iron hæmatoxylin) of the gravid female show the secretory product in quantities (Fig. 2) which stains blue and appears gra-

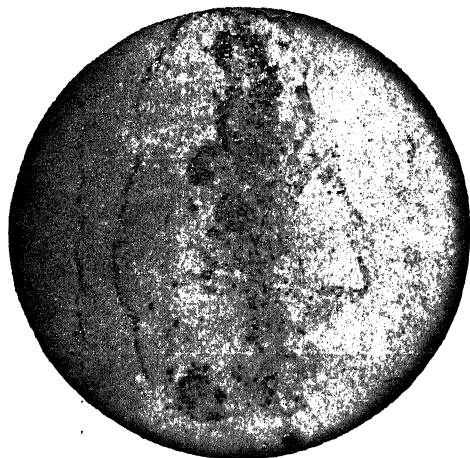


FIG. 2. Section of the same. Fixation in dichromate formal-acetic and stained in Heidenhain's iron hæmatoxylin. The large reniform body is the gland with the granular secretion collected on one side. The circular section adjacent to the gland is the aorta.

nular. The cells are fairly large with large nuclei, blue chromonemata and nucleoli. The cell limits are generally obsolete but the structure is not syncytial. The secretory product in the gland is Gomori-positive.

The role of the corpus allatum in female reproduction and the relation between neurosecretion and the corpus allatum in *Iphita limbata* Stal., are under investigation by experimental means.

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Co. 560 AND Co. 561 : SUGARCANE OR SORGHUM ?

CHONA AND MUNJAL¹ reported the occurrence of *Sphacelotheca* on sugarcane, the actual hosts being Co. 560 and Co. 561 which along with Co. 559, are progeny of a cross between G 1227 ♀ [*Saccharum officinarum* (Vellai) ♀ × *Sorghum halepense* ♂] and *Sorghum halepense* ♂ (Fig. 1). As a result of this back-crossing, characteristic

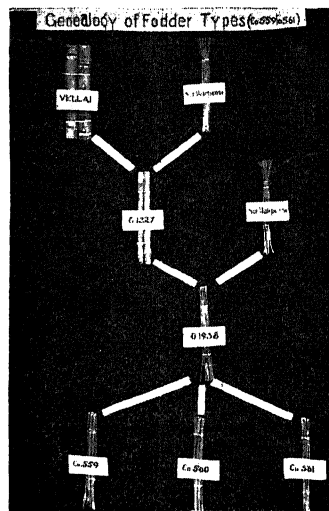


FIG. 1

features of sugarcane have been so drastically whittled down that the varieties in question (Fig. 2), resemble, to a very great extent, their grandfather, *Sorghum halepense* which was crossed with a noble cane to evolve "fodder canes" with reduced content of hydrocyanic acid.



FIG. 2

The distinguishing features of "Sugarcane" to which all the varieties of the three species of *Saccharum*, viz., *S. officinarum*, *S. barberi* and *S. sinense* and a majority of their progeny

belong, are (1) a morphological make-up, so characteristic of all the three species, and (2) a high percentage of easily recoverable sucrose in them. The occurrence of one or the other in a plant does not merit this name as was the case in a form of *Saccharum spontaneum* which was found to contain as high as 13 per cent. sugar in juice but not commercially available, as against 16-20 per cent. in sugarcane.² Co. 560 and Co. 561 have none of these attributes of sugarcane. To call them by this name, and to assign them to *Saccharum officinarum* would be something like calling Co. 563* and Co. 564, bamboos and placing them under *Bambusa arundinacea* which obviously is not correct.

It would, therefore, appear that the occurrence of *Sphacelotheca* on sugarcane has still to be recorded. So far, it has been noted on *Erianthus munja*³ amongst the plants belonging to the subtribe *Saccharineae*.

The author is indebted to Sri. N. L. Dutt for kindly supplying photographs reproduced as Figs. 1 and 2, and to Sri. K. L. Khanna for his keen interest in this note.

Central Sugarcane Res. Station, S. L. SHARMA.
Pusa, Bihar, January 9, 1953.

* Parentage of Co. 563 and Co. 564 is:—

Co. 349 ♀ × Bamboo hybrid IX ♂ which is one of the F₂ seedlings of a cross between P. O. J 213 ♀ and *Bambusa arundinacea* ♂.

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PRELIMINARY OBSERVATIONS ON A VIRUS DISEASE OF *THEVETIA* *NERIIFOLIA* JUSS.

PLANTS of *Thevetia neriifolia* Juss., growing as a hedge in Minto Road area of New Delhi, were observed during July 1948, to show severe smalling and curling of leaves. The leaf-margins in some cases were curled inwards or outwards. In most of the leaves, however, the margins were wavy and presented a more or less serrated appearance. There were fine chlorotic streaks running mostly along the finer veins and concentrated in the area adjoining the midrib or near the margins giving the leaf a unique pattern. The incidence of the disease in the locality was almost 100 per cent.

All experiments were conducted in an insect-proof house. Several attempts made during different periods of the year to transmit the disease by sap inoculation on young healthy

plants of *Thevetia neriifolia* Juss. raised from seed gave negative results. Also, the disease could not be transmitted by sap inoculation in the presence of carborundum powder to healthy plants of *Nicotiana tabacum* L., Varieties White Burley and Harrison's Special, *Nicotiana glutinosa* L., *Lycopersicum esculentum* Mill., Variety Sutton's Early Market, *Datura stramonium* L., *Capsicum annuum* L., *Solanum nigrum* L., and *Solanum nodiflorum* Jacq. The disease was, however, successfully transmitted by wedge grafting to *Thevetia neriifolia* Juss., *Datura stramonium* L., *Nicotiana tabacum* L., Varieties White Burley and Harrison's Special, and *Lycopersicum esculentum* Mill., Variety Sutton's Early Market.



Two to three weeks after grafting, young leaves on *Thevetia neriifolia* showed curling of the leaf-tips downwards or sideways accompanied by smalling of the leaves, asymmetry of leaf lamina and waviness of leaf-margins giving them a more or less serrated appearance. This was followed by the development of chlorosis along the finer veins mostly near the midrib, but in some cases starting from the leaf-margins and proceeding inwards towards the midrib. Later, all the above symptoms became more prominent. Fig. 1 shows a *Thevetia neriifolia* plant showing the symptoms of the disease transmitted to it by grafting. *Datura stramonium* plants about three weeks

after grafting showed rolling of leaf-margins inwards, curling of leaves downwards and interveinal yellowing. This was followed by wrinkling of the leaf-surface. Later on all these symptoms became more intensified except the inward rolling of the leaf-margins. Leaves subsequently developed showed marked smalling. Similar symptoms were observed on *Lycopersicum esculentum*. In the case of *Nicotiana tabacum* the symptoms produced were very mild, such as slight downward curling and faint mottling.

As the disease could be transmitted by grafting only, an attempt was made to determine the insect vector. Preliminary attempts aimed at transmission of the disease with aphids (*Myzus persicae* Sulz.) and white flies (*Bemisia tabaci* Gen.) were not successful and the vector of the disease still remains to be discovered.

As no record of a virus attacking *Thevetia nerifolia* is available, it will be interesting to continue the investigations further.

These experiments were conducted at the Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi, and I am grateful to Dr. R. S. Vasudeva for his keen interest in the work.

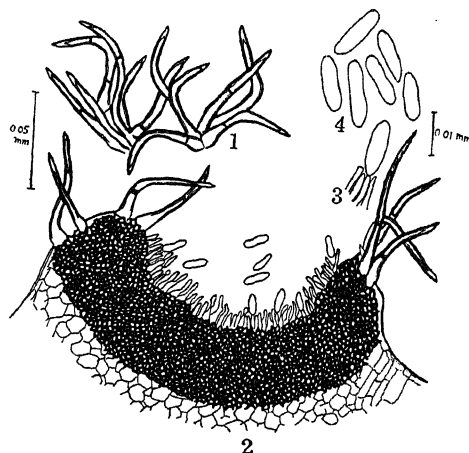
Dept. of Botany, R. P. GARGA.
Holkar College, Indore,
March 30, 1953.

ON THE OCCURRENCE OF A NEW SPECIES OF COLLETOTRICHUM ON POTHOS SCANDENS L.

DURING a routine visit to a neighbouring garden a fairly severe leaf-blight disease was noticed on *Pothos scandens* L., a common creeper. Occasionally two species of *Colletotrichum* were found associated with the disease, one of which resembled *C. capsici* (Syd.) Butler and Bisby. The other species differed in several morphological characters, such as the size and shape of conidia, conidiophores, setae and acervuli, from *C. pothi* Koorders once recorded on *Pothos* sp. from Java.⁴ Similarly, it also differed from some other species of the fungus reported on various members of Araceae from different countries.^{1,2,3,5} In view of the above, it is proposed here as a new species whose diagnosis follows:

Acervuli ut plurimum epiphylli, nonnumquam etiam in petiolis foliorum infectorum, brunnei, submersi, separati, diam. 59.5-164 μ , setosi vel aetosi. Setae plures cum adsunt, brunneae, generatim curvatae, nonnumquam fere ad angulum rectum, longiores quidem ad angulum rectum approximantes, continuae, vel semel vel bis septatae, fastigiatæ ad apicem, 31.5-88 μ

longae, 5 μ latae ad basim. Conidiophori hyalini, continui, cylindrici, 6-9.5 μ longi, 1.5 μ lati. Conidia hyalina, continua, oblonga vel plus minusve cylindrica, occasionaliter tenuiter contracta ad medium atque vel tenuiora ad apicem unum, 9.5-19 \times 4-6 μ .



Colletotrichum cylindricum sp. nov. (Figs. 1-4).

FIG. 1. Setae, FIG. 2. T. S. Acervulus, FIGS. 3 and 4. Conidiophores and Conidia.

Typus lectus in foliis et petiolis *Pothos scandentis* Linn. in urbe Poona, die 9 januarii, anni 1952, a cl. S. N. S. Srivastava. Typus positus etiam in Herb. I.M.I., Kew, England (No. 49133.)

The writer is grateful to Dr. S. P. Wiltshire for some suggestions, and to Dr. P. R. Mehta for advice and encouragement during the course of this work. Thanks are also due to Rev. Father H. Santapau for the Latin rendering of the diagnosis.

S. N. S. SRIVASTAVA.

Directorate of Plant Protection,
Quarantine and Storage,
Plant Quarantine Station,
Poona, March 30, 1953.

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AN EURYTOMID HYPERPARASITE ON STENOBRACON DEESAE (CAM.)

Stenobracon deesae (Cam.) is a well-known larval Braconid parasite of the sugarcane and jowar borers. Recently, a Eurytomid hyperparasite has been found to parasitize the pupae

of *Stenobracon* in Delhi. So far, except for a pteromalid hyperparasite recorded by Narayanan¹ and others, there is no record of any other hyperparasite attacking *Stenobracon*.

Only one small exit hole (Fig. 2, *ch.*) is bitten through and all the hyperparasites emerge out of the same hole. The parasite completes its life-cycle in about 13 to 15 days at 25°C. temperature and 70 per cent. relative humidity. Five *Stenobracon* cocoons were parasitized by the 4 unmated females and the progeny consisted of 61 males. Undoubtedly, the hyperparasite is capable of reproducing parthenogenetically.

This is the second record of another species of hyperparasite on this beneficial parasite. As the hyperparasite is highly prolific, the authors feel that the discovery of this hyperparasite on *Stenobracon* emphasises the need for examining the material more carefully before introducing the parasite in the field. Further work on the systematic aspect is in progress.

Division of Entomology, E. S. NARAYANAN.
Indian Agricultural B. R. SUBBA RAO.
Research Institute,
New Delhi, April 2, 1953.

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NOTE ON *CHARACIOSIPHON* *RIVULARIS* IYENGAR FROM GWALIOR

The genus *Characiosiphon* was described by Iyengar¹ who found the alga growing in tiny stones and pebbles inside the water in a shallow stream near Trichinopoly in South India. The author recently collected this alga in a channel in Gwalior. It was growing on different submerged objects such as leaves, twigs and pebbles in the shallow margins of the channel (Fig. 1). It kept growing in the

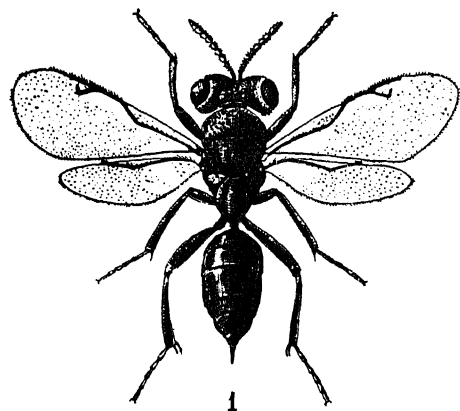


FIG. 1. Eurytomid female, × 15.

FIG. 2. *Stenobracon* cocoon showing exit hole of hyperparasite.

FIG. 3. *Stenobracon* cocoon healthy showing exit hole of parasite.

FIG. 4. *Stenobracon* cocoon cut open to show pre-pupal remains.

Lettering:—*ch.*, exit hole; *pr.p.r.*, *Stenobracon* pre-pupal remains.

From a number of *Stenobracon* pupæ collected in the field, it was observed that two of them were pale brown in colour as against the normal pale white healthy cocoons. From one of these cocoons, 8 female and 3 male hyperparasites emerged. From the second cocoon, 4 females emerged. The 4 unmated females were given *Stenobracon* pupæ that were in different stages of development for oviposition. It was observed that the female parasite started laying eggs a few hours after emergence if a host of suitable stage was provided. The hyperparasite selects the pre-pupal stage of *Stenobracon* for oviposition. The female pierces the tough parasite cocoon with its long curved but concealed ovipositor and lays eggs on the body of the host. The hyperparasite is definitely an external parasite, as the hyperparasitized *Stenobracon* cocoon when cut open shows pre-pupal host remains (Fig. 3, *pr.p.r.*).

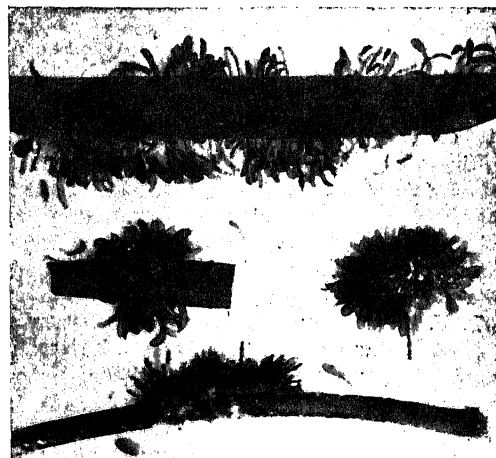
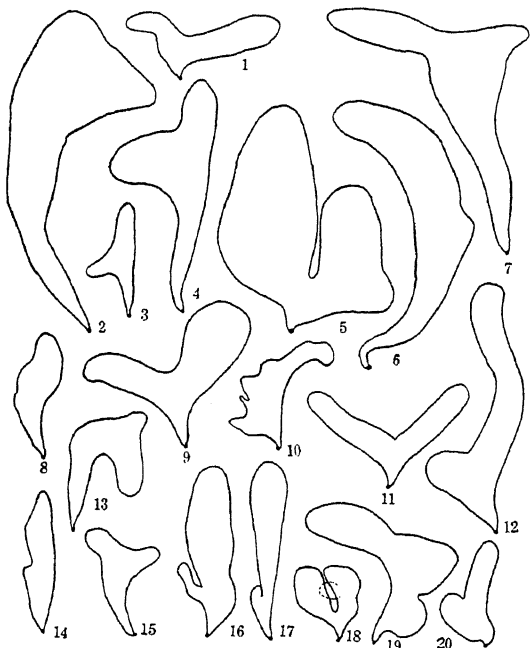


FIG. 1. Habit photographs of *Ch. rivularis* (about ½ nat. size).

channel for four months (September-December 1952) and then disappeared. The alga showed some new and interesting features.

The alga in all its features agrees with the type species. The thallus is cylindrical when young and becomes club-shaped later on. The alga is coenocytic with numerous discrete protoplasts which are exactly similar to those described by Iyengar.



TEXT-FIGS. 1-20. Thalli showing different kinds of lobation of the thallus ($\times 25$).

The Gwalior alga is more robust than the South Indian form and measures up to 1 cm. in length and 3-4 mm. in breadth, while the South Indian form measures up to 1 cm. in length and only up to 1 mm. in breadth. The Gwalior form is particularly interesting in the fact that some of the individuals showed a lobation of the thallus. These individuals are generally bilobed (Text-Figs. 1, 3-5, 9, 11, 12, 16, 17, 20) though a few showed more than two lobes (Text-Figs. 10, 18, 19). Such lobations of the thallus have not been described by Iyengar.

The author expresses his grateful thanks to Dr. T. V. Desikachary, University of Saugar, for his kind guidance, and to Dr. R. Misra and Prof. K. L. Saxena for kind facilities.

Victoria College,
Gwalior,
May 13, 1953.

M. S. AGARKAR.

A NEW SPECIES OF ARTHURIA

A LEAF rust on *Glochidion* sp. collected at Mahabaleshwar, Bombay, proved on examination to belong to the rust genus *Arthuria* Jackson, on account of the presence of sub-cuticular pycnia, caemoid aecia, uredia with urediospores developed in chains and telia with chains of one-celled hyaline teliospores, compacted together into a crust. Comparative studies indicate that *Arthuria* species on *Glochidion* differs in structure and spore measurements from the other known species of this genus, viz., *Arthuria catenulata* Jackson and Holw., *A. columbiana* (Kern and Whetzel) Cumm.¹ and *A. tylophorae* Ramakrishnan.² It is, therefore, proposed to establish a new species, viz., *Arthuria glochidionis* Gokhale, Patel and Thirumalachar, the details of which are given below:—

Arthuria glochidionis Gokhale, Patel and Thirumalachar, spec. nov.

Infectionis maculae ut plurimum in foliis, in petiolis quoque atque culmis succulentis, circulares vel polygonales, rosaceobrunneae, 3-5 mm. diam. Pycnia subcuticularia, amphigena atque caulicola, luteole, brunneae, 105-230 μ lata, absque paraphysibus ostiolaribus. Aecia pycniis consociata, caemioidea, absque serie peridiali, amphigena, alba, erumpentia atque pulverulenta; aeciosporae in catenis, subglobosae vel polygonales, incolorae, $33 \times 26 \mu$ ($26-40 \times 21-32 \mu$) parietibus dense verrucosis. Uredia hypophylla, dispersa, aeciis similia structura, subepidermalia, erumpentia; uredosporae catenulatae, aeciosporis similes figura sed illis minores magnitudine, viz., $25 \times 18 \mu$ ($21-31 \times 17-20 \mu$). Telia hypophylla, urediis consociata, apparentia ut minutae crustae luteolo-brunneae, producta ex catenulis basipetalibus, catenulis lateraliter coalescentibus atque efformantibus crustam compactam; sporae maturae subglobosae vel cuboideae, tenuibus parietibus praeditae, leves, $30 \times 19 \mu$ ($23-39 \times 17-23 \mu$) germinantes absque quietis spatio per promycelium externum ornatum 4 sporidiis.

Typus lectus in foliis *Glochidionis* spec. in loco Mahabaleshwar, Bombay, a V. P. Gokhale, mensa junio anni 1952.

Details will be published elsewhere.

College of Agriculture,
Poona-5, May 26, 1953.

V. P. GOKHALE.
M. K. PATEL.

1. Cummins, G. B., *Descriptions of Tropical Rusts-IV*, Bull. Torrey bot. Cl., 1943, 70, 517. 2. Ramakrishnan, T. S., *Some Interesting Rusts of South India*. Ind. Phytopath., 1950, 3, 43.

RELATION BETWEEN ANATOMICAL CHARACTERS AND CHROMOSOME NUMBERS IN *SACCHARUM* *SPONTANEUM* L.

Saccharum spontaneum L. is known to be a compound species, consisting of two sub-species and a number of varieties and to show a wide degree of variation. Chromosome counts of a number of clones have been recorded^{1,2} and the occurrence of polyploidy within the species has been observed and discussed.^{3,4} Since then over 200 variants have been collected by the Spontaneum Expedition Scheme⁵ from various parts of the Indian Union and over a 100 imported from other parts of the distribution area. Haploid chromosome numbers have been determined by clear counts made on iron-acetocarmine smears of pollen mother-cells of about 100 variants. These counts show what appears to be a polyploid series ($n = 24, 32, 40, 48, 56$ and 64) with aneuploid forms occurring in three of the groups ($n = 24, 32$ and 64) of the series.⁶ The following anatomical and other characters were studied by the writers in relation to these chromosome number groups: (1) diameter of the pollen-grains, (2) size of the stomata (long dia. \times short dia.) of the lower and upper epidermes of the lamina, and (3) width of long cells of the epidermis of the internode. All the variants available in each group (Table I) were included in the study; in the $n = 32$ group, however, out of the 70 variants available, a sub-sample of 14 forms covering the geographical range of the species was studied. Means were worked out for 30 readings in each case.

TABLE I

| Chromosome group # No. of variants studied | Pollen-grain diameter (in microns) | Size of stomata (in microns) | | Width of long cells in stem epidermis (in microns) |
|-----------------------------------------------|------------------------------------------|---------------------------------|--------------------|-------------------------------------------------------------------|
| | | Lower epidermis | Upper epidermis | |
| 24 | 4 45.9 \pm 0.34 | 896 \pm 10.2 | 892 \pm 8.8 | 10.3 \pm 0.97 |
| 32 | 14 47.3 \pm 0.42 | 1188 \pm 5.0 | 1197 \pm 4.7 | 12.0 \pm 0.92 |
| 40 | 6 50.5 \pm 0.33* | 1310 \pm 8.9 | 1295 \pm 9.5 | 13.7 \pm 0.84 |
| 48 | 2 † | 1348 \pm 21.7 | 1459 \pm 20.3 | 14.1 \pm 1.86 |
| 56 | 4 52.8 \pm 0.62 | 1516 \pm 11.9 | 1570 \pm 13.2 | 16.6 \pm 1.53 |
| 64 | 3 63.3 \pm 0.50 | 1814 \pm 22.1 | 1773 \pm 21.5 | 20.4 \pm 1.96 |

* Mean for 2 variants, the rest failed to flower.

† These variants failed to flower.

These anatomical data (Table I) show a positive relationship between the dimensions of the cells and the chromosome number. In the case of characters (1) and (2) the differences between the group means have been found to be statistically significant. In the case of (3), the intra-group variation is wide and even though there is an increase in cell width with progressive increase in ploidy, the differences have not come out significant with the present sample.

Treating the pollen-grain as a simple sphere, it is found that for a 100 per cent. increase in chromosome number (as between the $n = 32$ and $n = 64$ groups), the increase in cell volume is 140 per cent., which is much larger than what has been recorded in *Poa*.⁷

Further work is in progress.

Thanks are due to Shri N. L. Dutt and R. R. Panje for their help and guidance.

Sugarcane Breeding J. T. RAO.

Institute,

A. BALASUBRAMANIAN.

Lawley Road P.O.,

Coimbatore, May 26, 1953.

1. Bremer, G., *Genetica*, 1925, 7. 2. Starrett, R. C., as reported by Artschwager in *Tech. Bull.*, 1942, No. 811. *U.S. Dept. Agri.* 3. Ammal, E. K. J., *Ind. Journ. Agri. Sci.*, 1936, 6. 4. Parthasarathy, N. and Subba Rao, K. S., *Ind. Journ. Gen. and Pl. Br.*, 1946, 6. 5. Panje, R. R., *Proc. 1st Bien. Conf. Sug. Res. Workers*, 1951. 6. Unpublished data of Spontaneum Expedition Scheme, Sugarcane Breeding Institute, Coimbatore. 7. Muntzing, A., *Hereditas*, 1940, 26.

NODOSTOMA BENGALENSE DUV. VAR. A NEW EUMOLPID PEST OF JUTE

Nodostoma bengalense Duv. var. was first observed attacking jute plants (*Corchorus olitorius*) during June 1952 along with *Cleoporus lefevrei* Duv.

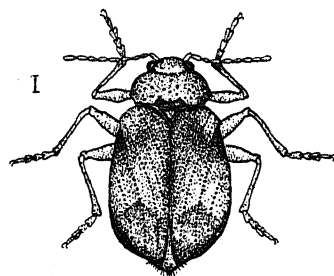


FIG. 1

The species *bengalense* was first described by Duvivier¹ in 1891 and Jacoby² records the habitat to be Bengal and Burma, but without mentioning the host plants. The insects are

about 4½ mm. in length. Thorax with few punctures, with the sides produced to form a rather sharp angle. Body with dull yellow-coloured and partly punctured elytra. A few punctures on the head. Antennæ eleven-jointed, filiform. Base of the elytra strongly raised, with a deep depression below containing a few deep punctures (Fig. 1). The posterior portion of the wings rather deeply pigmented, which, when folded in impart a blackish colour to the hinder parts of the elytra.

Though these insects were feeding along with the *C. lefevrei* on the same plants, their attacks were restricted to the leaves only, while *C. lefevrei* was seen to feed on the bark of the plants also. During 1952, attack by *N. bengalense* was reported from one place only, and the pest was controlled quickly by spraying with DDT. No phytotoxic effect due to spraying was noticed on the plants.

It may be mentioned that the authors have already recorded another Eumolpid *C. lefevrei* Duriv. as a pest of jute in West Bengal during 1951.³

The authors wish to express their indebtedness to the Commonwealth Institute of Entomology, London, for kindly identifying the insects. Sincere thanks are also due to Sri. B. K. Bera for valuable help.

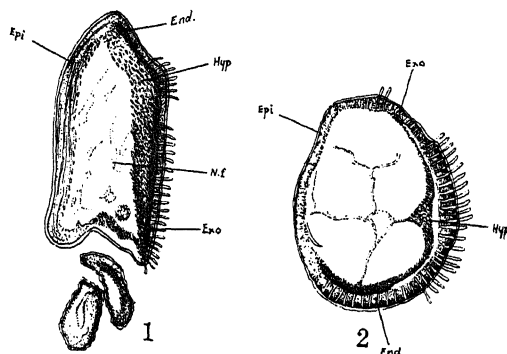
State Agricultural SAURENDRANATH BANERJI.
Res. Institute, DILIP K. DUTT.
Tollygunge,
Calcutta, May 26, 1953.

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THE MORPHOLOGICAL STRUCTURE OF THE FIRST TARSAL JOINT OF THE HIND LEG IN *PYRILLA PERPUSILLA* WALK., AND ITS BEARING ON SUSCEPTIBILITY TO INSECTICIDES*

THE epicuticle (Fig. 1, *Epi*), as also the exo-cuticle (*Exo*) of the first tarsal joint in *Pyrilla perpusilla* Walk., is as usual uniformly thin but distinct throughout. The outer wall of the epicuticle is, however, peculiar in that it is traversed by a series of rather thick spatulate setæ slightly curved at the tip, which appear to pass through the more or less undifferentiated endocuticle and thus reach inwardly the surface of the well-developed series of elongated ovoidal hypodermal cells (*Hyp*) arranged in a thick more or less well distributed layer. The nuclei

of these cells are distinct and are stained deep blue with hæmatoxyline. The layer of hypodermal cells extends from the dorsal margin of the first tarsal joint along the external wall right upto the ventral part but is conspicuously reduced and becomes undifferentiated on the inner wall (Fig. 2).



Since the series of hypodermal cells in layers on the outer wall of the first tarsal joint is situated just below the epi- and exo-cuticular layers which are traversed by deep-rooted specialized setæ mentioned above and moreover, as there is every likelihood of the lipoid layer of the epicuticle being continuously abraided by the frequent jumping habit of the Fulgorid, it is likely that the penetration of the water dispersible insecticide particles (B.H.C., and solutions of nicotine sulphate) through the cuticle and subsequently along the roots of the setæ right upto the vital hypodermal cells becomes a possibility, thus resulting in the death of the insect. The average results obtained indicate in general that the insecticides applied on the first tarsal joint are definitely more effective than those applied on the thorax. Similar morphological studies in this direction by Slifer¹ indicated that the undersurface of the arolia of *Melanoplus differentialis* (Thomas) lacked the protective layer of cement which in other areas of the leg protects the waterproof lipoid film present in the outermost layer of the cuticle. Slifer thus concluded that because of the absence of the cement layer, the wax on the ventral surface of the arolium is easily dissolved by lipid solvents, and the inner layers which remain there, offer little resistance to the penetration of various materials including dyes and insecticides. It is also likely that these protective layers become denuded by abrasive action specially on the arolia (*Euplantulæ*) of the true phytophilous type, such as *M. differentialis* as also on the first tarsal joint of the hind leg of a similarly active phytophile-*Pyrilla perpusilla* Walk. The finding of

Slifer also supports the experimental results obtained by Kennedy, Ainsworth and Toms.² Slifer's³ experiments conducted later indicated a similar absence of cement layer from other cuticular areas, viz., the antennal crescents, fenestræ, etc., in *Locusta migratoria migratorioides* R. & F., where the outer layers are similarly thin as in the case of first tarsal joint of *Pyrilla perpusilla* Walk., but the cellular layer beneath the antennal crescent in *Locusta migratoria migratorioides* R. & F., appears to be less prominent and more uniformly arranged when compared to that of the first tarsal joint in the hind leg of *P. perpusilla*. It is, however, not known as yet whether these thermoreceptive areas with their poorly sclerotized cuticle, lacking in a cement layer, as described by Slifer, are also regions vulnerable to aqueous suspensions of insecticides. Attempts are also being made to trace similar areas in various stages of *Schistocera gregaria* Forsk., with a view to find out their response to various insecticides.

Ind. Agric. Res. Inst.,
New Delhi,
May 26, 1953.

S. MUKERJI.
V. G. PRASAD.

* The problem involved formed part of the thesis of be Junior Author for Associateship of the Indian Agricultural Research Institute, New Delhi.

1. Slifer, E. H., *Ann. Ent. Soc. Amer.*, 1950, **43**, 173. 2. Kennedy, J. S., Ainsworth, M. and Toms, B. A., *Anti Locust Bull.*, No. 2, [*Brit. Mus. (Nat. Hist.)*, London], 1948. 3. Slifer, E. H., *Proc. Roy. Soc.*, 1951, **38B**, 414.

EMBRYOLOGY OF *EUGENIA JAMBOS* L.

L. VAN DER PIJL¹ published an account of *Eugenia jambos* in which he reported that the megaspore mother-cell directly gives rise to a 5-nucleate embryo-sac without the intervention of megaspores. The two chalazal nuclei of the 4-nucleate embryo-sac are said to function as polar nuclei and the egg and one synergid are said to be sister-cells formed by the division of the two micropylar nuclei. In his paper on polyembryony in *Eugenia*, Tiwary² did not trace the origin of adventive embryos in *E. jambos*.

During an embryological study of *E. jambos*, material of which was collected from Botanical Garden, Forest Research Institute, Dehra Dun, I made the following observations:

The youngest ovules sectioned showed a crassinucellate condition with a very deep-seated elongate megaspore mother-cell which undergoes the usual meiotic divisions to form

a linear tetrad (Figs. 1 and 2). The chalazal megaspore functions. The degenerating remnants of the remaining three megaspores can be differentiated quite easily from the degenerating nucellar cells surrounding the embryo-sac and I can state definitely that the megaspore mother-cell never functions directly as the megaspore as indicated by Pijl. Occasionally one of the dyad cells may show belated division (Fig. 3) and rarely a megaspore, other than the chalazal, may show some enlargement. Frequently the degenerating megaspores form a very long densely staining streak above the functioning megaspore (Fig. 4).

The embryo-sac passes rapidly through the 2-, 4- and 8-nucleate stages which are quite typical (Figs. 5, 6, 7 and 8). The synergids are very conspicuous vesicular structures (Fig. 9).

In exceptional cases at the 2-, 4- and 8-nucleate stages all the nuclei may be seen grouped together near the centre of the embryo-sac. Many embryo-sacs showed an irregular disposition of nuclei, whose number was variable, sometimes more and sometimes fewer than eight (Fig. 10). A fusion of adjacent embryo-sacs seems possible and might explain the larger number of nuclei. The smaller number may be caused either by an early degeneration of some of the nuclei or occasional abortive divisions.

In a few instances the narrow chalazal end of the embryo-sac was found to penetrate between the cells of the chalazal tissue, thus giving the appearance of a chalazal haustorium. In some other cases the mature embryo-sac was found to have digested its way through the nucellar tissue and come in contact with the cells of the integument (Fig. 11).

Pijl has reported a degeneration of one of the synergids on the entry of the pollen tube but my observations indicate that quite frequently both the synergids may remain intact even after fertilization (Fig. 12).

Although Pijl supports normal fertilization by various indirect methods he does not clearly mention the fate of the zygote. My observations show that the egg degenerates in most cases and this is followed by nucellar budding from different places around the embryo-sac (Fig. 13). In my preparations only one ovule showed a zygotic embryo with a very short suspensor (Fig. 14). In this case nucellar embryos were absent.

The adventive embryos are formed by irregular divisions of the nucellar cells which project into embryo-sac. A number of them of

various ages were found in healthy as well as in degenerating ovules (Fig. 15). If endosperm is not formed and the embryo-sac is obliterated they eventually degenerate but in healthy embryo-sacs their growth continues and more than one may reach maturity. Mature nucellar embryos usually show unequal cotyledons.

ment becomes highly differentiated consisting of small cells with dense cytoplasm. In several places this inner specially differentiated part of the integument may comprise more than one layer.

I wish to express my sincere thanks to Prof. P. Maheshwari for constant guidance and

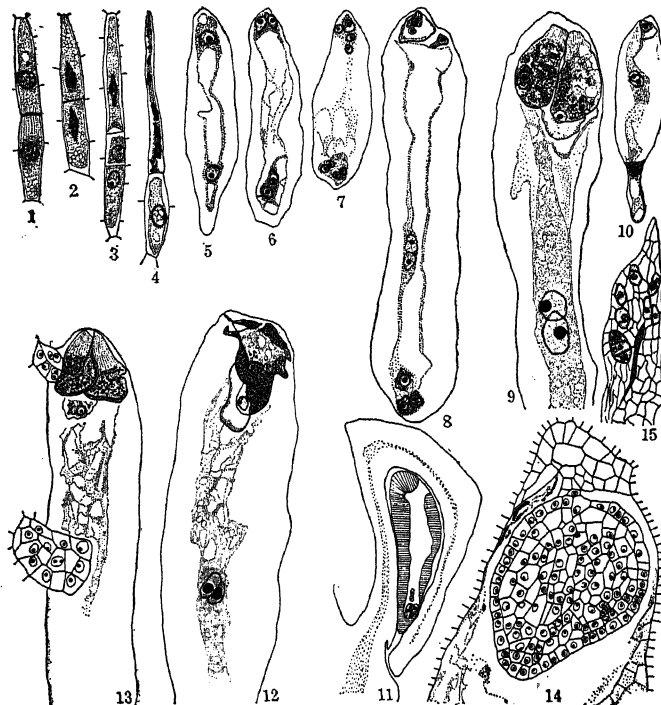


FIG. 1. End of meiosis I, $\times 94$. FIG. 2. Dyad cells in meiosis II, $\times 94$. FIG. 3. Belated division of upper dyad cell, $\times 94$. FIG. 4. Functioning megaspore, $\times 94$. FIG. 5. 2-Nucleate embryo-sac, $\times 56$. FIG. 6. 4-Nucleate embryo sac, $\times 56$. FIG. 7. 8-Nucleate embryo-sac, $\times 56$. FIG. 8. Same, older stage, $\times 56$. FIG. 9. Part of mature embryo-sac showing prominent synergids, $\times 225$. FIG. 10. An embryo-sac, with the antipodals, polar nuclei and egg; the synergids are missing. The chalazal end is forming a sort of haustorium-like structure. $\times 56$. FIG. 11. Mature embryo-sac which has digested its way towards the chalaza, $\times 56$. FIG. 12. Embryo-sac after fertilization, $\times 56$. FIG. 13. Two nucellar embryos, $\times 56$. FIG. 14. Zygotic embryo, $\times 25$. FIG. 15. Micropylar portion of nucellus of a degenerating ovule showing adventive embryos; note obliterated embryo-sac, $\times 24$.

The endosperm is free nuclear. It is the micropylar end that attains the cellular condition first. However, the cells are poor in plasma and the whole endosperm is absorbed by the developing embryo. In older stages the nucellus also gets absorbed completely excepting a few cells at the micropylar region. Eventually these two are absorbed, so that the embryo-sac is surrounded directly by the massive integument. The innermost layer of the integu-

ment becomes highly differentiated consisting of small cells with dense cytoplasm. In several places this inner specially differentiated part of the integument may comprise more than one layer.

Dept. of Botany,
Banaras Hindu University,
Banaras-5, July 1, 1953.

S. K. Roy.

1. Pijl, L. van der, *Rev. Trav. Bot. Néerland*, 1934, 31, 113-87. 2. Tiwary, N. K., *Jour. Ind. Bot. Soc.*, 1926, 5, 124-36.

REVIEWS

Statistical Methods for Chemical Experimentation, Vol. I. By W. L. Gore. (Interscience Manuals), 1952. Pp. ix + 210. Price not given.

This book attempts to present chemists (and experimenters in other fields as well) with an account of the methods available for the statistical analysis of experimental data. The basic theory is completely excluded, only the final formulæ useful to the practical worker being given in the book. A number of tables required for the application of the formulæ are included at the end and the formulæ themselves are repeated in a collected form in Appendix B.

The treatment is 'straightforward' in that the reader is told what to do if a particular analysis is required. It has its own advantages and the book is well edited for this purpose; but the complete absence of the *raison d'être* of the various processes leaves one with a feeling of helplessness about a problem arise which is different from those treated in the book. The reviewer found the book not easy to read, both because of this difficulty of appreciating why a particular procedure is followed and also because of the involved style, as the following sentence chosen at random (p. 23) would show:

"It is by examining the properties of these derived distributions of statistics calculated from samples that it becomes possible to determine the reliability of statistical estimates."

However, the scope of the book is fairly wide, as would be clear from the following chapter headings: Statistical Concepts, The Reliability of Estimates, Analysis of Variance, Design of Experiments, Correlation and Regression, Attribute Statistics. It would therefore be a useful addition to technical libraries.

General Astronomy. By Sir Harold Spencer Jones. (Edward Arnold & Co., London), 1951. III Edition. Pp. 456. Price 30 sh. net.

The present edition which appears 17 years after the publication of the second edition retains the original plan of the previous editions, while the subject-matter has been completely revised and brought up-to-date. While not designed as a formal text-book for University Examinations, the first ten chapters will be very valuable, by way of reference, to students and teachers alike. In these chapters, problems

dealing with the motions of the earth, the sun, the moon and the planets are explained with lucidity and precision, and there is a chapter giving a description of modern astronomical instruments and their uses. The chapter on the sun gives a summary of the present knowledge regarding the physical condition of the sun and of allied topics like the solar spectrum, sunspots, etc. Many, however, may not agree with the author when he advocates the reform of the calendar so as to consist of 4 equal quarters of 91 days (13 weeks) with one month of 31 days, followed by two months of 30 days each, with an undated *World's Day* in the middle of the year, and with an additional *Leap Day* at the end of the leap years.

Four chapters on the stars give a comprehensive and up-to-date account of our present knowledge about stars and measurements and laws relating to them, and the galactic and extra galactic systems. These chapters give practically all the general knowledge about stellar astronomy that the general mathematician or physicist, who is not going to be a specialist in astronomy, need know. The last chapter of the book mentions some of the current and unsolved problems of modern astronomy, and succinctly explains the present theories of cosmogony, including the origin of the spiral nebulae, star clusters, binary and multiple stars, and the solar system.

A mine of authoritative and up-to-date information is condensed into some 440 pages. The book will be widely welcomed by every one who is anxious to know the contents of general astronomy.

C. N. S.

Institute of Physics Monographs for Students:

- (1) *Fundamentals of Thermometry.* By J. A. Hall. (Pp. 48.)
 - (2) *Practical Thermometry.* By J. A. Hall. (Pp. 51.)
 - (3) *Soft Magnetic Materials Used in Industry.* By A. E. De Barr. (Pp. 62.)
 - (4) *The Magnetic Circuit.* By A. E. De Barr. (Pp. 62.)
- (Published by the Institute of Physics, London), 1953. Price 5 sh. each.

This series of booklets is mainly intended for students studying for the Higher National Certificate in Applied Physics issued by the Institute of Physics. However, they are sure to be greatly appreciated by a much wider class of readers. The first two books on thermometry

deal with the principles of temperature measurements and the practical details concerning various types of instruments employed for this purpose. All the three types of thermometers, the platinum resistance, the thermocouple and the optical pyrometer, are considered in good detail. The emphasis is upon the International Temperature Scale, with defined fixed points, rather on the absolute thermodynamic scale. Many of the details given in these two books will be found useful by research workers in other branches of physics who find it necessary to measure temperatures with reasonable precision.

The two books on magnetism deal with the properties of ferromagnetic materials and how to make them into magnets for use in instruments. They contain a fine review of the various available data, and the presentation is greatly simplified by the inclusion of a large number of graphs and tables. While Booklet 3 deals with only soft magnetic materials such as the silicon-iron and nickel-iron alloys, Booklet 4 contains in addition to a description of the magnetic circuit and its applications, also a short account of permanent magnet materials, the ferrites and special materials such as Fe-Co alloys and Perminvar. It is unfortunate that the contents are far too biased towards industrial applications and that applications in pure research are completely omitted. For instance, there is no mention anywhere of the design of electromagnets to produce large magnetic fields, or the nature of the materials used in their construction. However, the two books will be much appreciated by electrical engineers and instrument technologists.

G. N. RAMACHANDRAN.

Field Experimentation with Fruit Trees and Other Perennial Plants. By S. C. Pearce. (Technical Communication No. 23 of the Commonwealth Bureau of Horticulture and Plantation Crops, East Malling, Maidstone, Kent, England.) Pp. 131. Price 10sh. or \$1.40.

This book is 'addressed to the practical experimenter and not to the mathematician, who will find little that is novel'. It contains some 'ideas' and new 'techniques' which the author developed as a member of the Statistics Section of East Malling applying statistical methods to problems of experimentation. The concepts and practice of design of experiments are developed with special reference to fruit and other perennial plants. Practical difficulties in field

experimentation are fully discussed and methods of solving them have been suggested. This special feature of this book is probably the result of author's experience in this field.

Starting from the simple randomised block design and Latin Square, more complicated designs, such as multiple Latin Squares, split-plots, criss-cross, stripe, tile and incomplete block designs have been introduced and the situations in which they are likely to be useful have been indicated. Further problems treated are the use of covariance analysis, determination of optimum size and shape of the plot from uniformity trial data, the importance and use of trial designs, transformation of the variables for analysis of variance, analysis of complex experiments conducted over several years and adjustments for missing plots.

The book ends with a series of appendices on (1) methods of analysing data for orthogonal designs; (2) partitioning of treatment sum of squares in an orthogonal design; (3) a general method of analysing designs; (4) analysis of covariance in an orthogonal design and a comprehensive list of references. The appendices are illustrative in character and are extremely useful in a book of this kind. On the whole, though limited in scope, the book covers a good ground and will be of use to the practical experimenter who has some knowledge of statistical methods and who can properly interpret tests of significance.

C. RADHAKRISHNA RAO.

Geometrical Optics. By C. Curry. (Edward Arnold & Sons), 1953. Pp. viii + 174. Price 21 sh.

The author claims in his preface that the book has been written "to give a more balanced account of the subject in which the underlying physical principles and the ultimate application to optical instruments and their design are always kept in view". A certain amount of success has been achieved in this direction, though one can normally expect a higher standard of performance. Suitable text-books on this subject are rather rare, and to that extent, Mr. Curry's book is certainly welcome.

The first few chapters form the basis for a proper understanding of the subject. The treatment conforms to the usual level and includes a good presentation of the Lagrange and Newton formulæ, aplanatic points, the optical sine relation, the cardinal points of lens system, etc. A beginning has been made on the topic of trigonometrical ray-tracing, but has been termi-

nated rather abruptly asking the student to refer to Conrady's *Applied Optics and Optical Design*. It would have been a very welcome change, if the subject has been pursued further leading to the full data for the computation of a lens system like a simple achromat. A student of practical applied optics would then have found ample scope for a fuller appreciation of the usefulness of this aspect of the subject.

The most welcome feature of the book is the chapter on "Aberrations of Optical Systems". The treatment is simple and well-suited for a beginner and is a good presentation of a rather difficult topic. Nice illustrative figures are given wherever necessary. The book concludes with a chapter on the "Design of Optical Instruments". The author contents himself with giving a detailed description of the various optical components. Again, a student of practical applied optics would certainly miss some of the details that he wants, were he to launch upon a programme of designing and making a component himself.

The book is certainly to be welcomed for the very elegant treatment adopted.

S. HARIHARAN.

Volume and Integral. By W. W. Rogosinski. (Oliver & Boyd, London), 1952. Pp. 156. Price 10 sh. 6 d. net.

This book of 156 pages gives a clear account of the Lebesgue-Integral (*absolute integral*), and is intended for the Honours students. The book gives an excellent introduction to the subject by properly setting forth the background; those who consider that the Honours syllabus should certainly include the modern notion of the Integral—this modern notion is about 50 years old—will find in it a suitable text-book.

The needs of the students have been kept in mind by the author who has brought out the geometrical aspect of integration. The book is self-contained and has six chapters, mostly of about 25 pages each; the chapter on the Lebesgue-Integral contains 35 pages. The first chapter is on sets of points. The second chapter deals with the notion of *content* as defined by Peano and Jordan; at the end of the chapter it is pointed out that, despite its apparent efficiency and conformity to intuition, this definition of content leaves much to be desired from the purely mathematical point of view. The third chapter is on *measure*; its last two articles deal with non-measurable sets and Vitali's covering theorem. The fourth chapter gives an account of the Riemann-Integral, and the last

article in the chapter is about the deficiencies of this integral. The fifth chapter is on Lebesgue-Integral and the sixth is on integration and differentiation according to Lebesgue.

The book contains 35 exercises and their solutions have been indicated. The last theorem in the book bears the number 101. Besides these, there are full discussions of some examples, such as, for instance, Volterra's example of a function $f(x)$ whose derivative $f'(x)$ exists for all values of x , $f'(x) \leq 3$ and yet $f'(x)$ is not Riemann-integrable. The book contains an index.

T. V.

Fatigue of Metals. By R. Cazaud. Translated by A. J. Fenner. (Chapman & Hall, Ltd.), 1953. Pp. xiv + 334. Price 60 sh. net.

This book, written by a leading authority on the subject is a welcome publication. It has an unusually large coverage of the available literature and the author's own contributions to it. A very comprehensive bibliography adds to the value of the book.

In the first chapter, the author briefly outlines the work done since 1829. Chapter II deals with the fundamental characteristics of fatigue fractures, their development under different stress systems and then describes various methods for the detection of fatigue cracks. Chapter III deals with earlier theories of failure by fatigue and their inadequacy in the case of dynamic stresses and also the subsequent theories of secondary stresses, limiting strain energy, etc., but points out that they are not sufficient to explain the fatigue failures. The next chapter describes types of stress systems in fatigue testing and various testing machines, which are in common use on the continent and U.K. At times their description is sketchy, but this is obviously beyond the scope of this book.

Chapter V reviews published data regarding fatigue limits of important steels and other alloys. The next four chapters present the data comprehensively showing the influence of various factors such as internal stresses, notches, threads, size and shape of parts and their surface conditions, corrosion, type of joints, etc., on fatigue strength.

The last chapter deals with various methods of improving the fatigue strength of machine components in service, from a consideration of the preceding test results, *viz.*, smooth surface finish, introduction of compressive stresses in the surfaces, nitriding, generous fillet radii, rounding the roots of threads, etc. The chapter also discusses methods of design and choice of

materials, and methods of evaluating stress and stress concentrations in machine parts.

One never feels, while reading the book, that it is a translation, and Mr. Fenner has done a splendid job. There are, however, a few printing errors.

R. C. DESHPANDE.

Pollen Morphology and Plant Taxonomy Angiosperms. By G. Erdtman. (Almquist and Wiksell, Stockholm and *Chronica Botanica*, Waltham, Mass.). Pp. 539. 261 illus.

Palynology, the study of the pollen grains of flowers and the spores of ferns and other flowerless plants, has lately grown out to a separate branch of science with a large literature. The study of these small, mostly one-celled objects is of interest from many points of view, purely academic as well as practical. They vary extremely much in size and shape and particularly in the structure of the cell wall, which is composed of one of the most resistant substances produced in the plant kingdom. Each plant species has its own type of pollen. Mostly, the pollen grains of closely related plant species cannot be distinguished from each other, but in the case of genera, the difference is often very characteristic.

The study of the form and minute structure of the pollen grains is in itself of interest and throws light on some important questions of cell and cell-wall formation. Palynology has further connections with many other branches of science: Systematics, in so far as the form of the pollen grains is one of the characters which should be taken into consideration when the affinities of plant groups are discussed. Geology and palaeobotany, because pollen grains in peat, lake deposits and other sediments reveal what kind of vegetation there was in the vicinity when the sediment was laid down. The detailed and reliable knowledge we now have of the history of the vegetation, and particularly of the forests, of the Northern Hemisphere in the Quarternary period is based almost entirely on the pollen analysis combined with the study of the stratification of peat, lake deposits, and so on; this has also thrown light on changes in climate, on pre-historic chronology, on the history of early agriculture, etc. Further connections and applications of palynology lead to so widely separate fields as the study of allergic diseases (Hayfever) and the control of honey, to mention two extremes.

Our knowledge of pollen has increased enormously during the last decades. Dr. Erdtman

(Stockholm), the leading specialist in this field, has now given us the first comprehensive book on modern palynology, based on the extensive literature and on the results of his own investigations. The book contains chapters of a general character, concise description of methods, and definition of the overwhelming number of terms which palynologists, including the author, have found necessary for the description of the pollen grains. By far the largest part, however, consists of the description and discussion of the pollen morphology of the various families, which are arranged alphabetically. This part (pp. 28-458) contains a wealth of new observations. The book is abundantly illustrated with excellent drawings, the standard magnification being 1,000.

For all those who in any way have to deal with pollen (and their number is steadily increasing), this book is a most welcome one. It shows clearly the present status of our knowledge in this field, it opens new paths for studies, and it gives a solid basis for all our work on pollen.

OVE ARBO HOEG.

Books Received

Reactivity of Free Radicals. (Discussions of the Faraday Society, No. 14), 1953. Pp. 256. Price 35 sh.

National Register of Scientific and Technical Personnel in India, Vol. III, Part I. (Scientists and Technologists.) (Published by the Council of Scientific and Industrial Research, New Delhi.) Pp. 578. Price Rs. 12.

Tables of Chebyshev Polynomials S_n^ and C_n^* .* (U.S. Dept. of Commerce, National Bureau of Standards, Applied Mathematics Series, No. 9). Pp. xxix + 161. Price \$25.00.

The Proteins, Vol. I. (Chemistry, Biological Activity and Methods), Part A. Edited by Hans Newrath and Kenneth Bailey. (Academic Press), 1953. Pp. xi + 548. Price \$12.00.

Method for Determining the Resolving Power of Photographic Lenses. (U.S. Dept. of Commerce, National Bureau of Standards, No. 533.) Pp. iv + 27. Price 75 cents.

Advances in Enzymology. Edited by F. F. Nord. (Interscience Publishers), 1953. Pp. x + 470. Price \$9.25.

Bibliography on the Genetics of Drosophila. By Irwin H. Herskowitz. (Commonwealth Circulation Bureau of Animal Breeding and Genetics, Edinburgh.) Pp. xi + 212. Price 21 sh.

SCIENCE NOTES AND NEWS

Margosa Leaves to Prevent Sprouting of Tubers During Storage

Dr. S. L. Tandon, Department of Botany, University of Delhi, writes as follows:

Considerable losses usually occur during the storage of potatoes due to sprouting, the sprouted tubers being of no table or seed value. Our investigations show that dry margosa leaves along with sand can advantageously be used as storage medium for potatoes because of their pronounced inhibiting effect on the sprouting of tubers. Only about 2 per cent. sprouted even after 180 days' of storage.

X-Ray Image Amplifier for Medical Use

Radiologists and physicians have a new tool in the X-ray image amplifier—a device that will give them a 200 times brighter view of their patient's internal organs in living action. Basically, the amplifier consists of a high vacuum tube that electrostatically focusses and accelerates an electron stream. Increased brightness of the X-ray image has been attained by converting the X-ray energy into light with a fluorescent screen, and thence to electrons by means of an adjacent photoelectric surface. These electrons are accelerated by a high potential placed across the vacuum tube, giving a brightness gain of 10 or more. A further gain is attained by electrostatic focussing of the electron stream to reduce the image to approximately one-fifth its original size. The reduced image, made up of high speed electrons, impinges on a phosphor output layer that converts the electron stream back to a visible image, now brightened 200 times or more. As a final step, the intensified image is magnified by means of an optical system without loss of the increase in brightness.

Nuclear Physics in London University

The first laboratory at a British University for Engineering Under-Graduate Training and Research in the techniques of nuclear physics was opened recently at Queen Mary College, London University. The laboratory's equipment includes a 1,000,000 volt impulse generator, the type of machine used by Cockcroft and Walton in their pioneer experiments on the artificial transmutation of the atom, and a 1,000,000 volt Vander Graff generator which

was built in the Department of Electrical Engineering to the specifications of the Atomic Energy Research Establishment at Harwell.

Structure of Desoxyribonucleic Acid

Franklin, Gosling, Stokes and Wilson of King's College, London; Wilkins of Medical Research Council; and Crick and Watson of Cavendish Laboratory, Cambridge, have proposed a structure derived from X-ray data and from stereochemical consideration for desoxyribonucleic acid ("DNA"). It suggests a possible way in which "DNA" might duplicate itself. "DNA" is a very long thin molecule, which is believed to carry at least part of the genetic specificity of the chromosomes in living cells.

Italian Research in Indian Ocean

An Italian expedition of four has arrived in Dar es Salaam to seek new evidence of the theory that Africa was once joined to Asia by a southern continent stretching over what is now the north-west part of the Indian Ocean. They believe that Madagascar, the Comoros, the Seychelles, and the Laccadive Islands are the surviving links of the submerged continent. Around these islands the expedition will search for clues to the old continent, especially through a detailed study of fish.

Water Disinfection with Iodine

The advantages of iodine over chlorine for disinfection of potable water has been recently stressed. It is stated that 8 parts per million of elemental iodine completely destroy 30 cysts per litre in 10 mts. in most natural waters. The iodine is in form of tetraglycine hydroperiodide which in combination with a mild acidifying agent releases nascent iodine. The periodide and the acid are incorporated in a tablet with talc and each tablet contains 20 mg. of the periodide.

Bursaries for Scientists

The Royal Society and the Nuffield Foundation, in order to fill a need in Commonwealth scientific relations, have decided jointly to initiate a Commonwealth Bursaries Scheme. The object is to provide facilities for increasing the efficiency of investigators of proven worth by enabling them to pursue research, learn techniques or follow other forms of study in

places in the Commonwealth which are peculiarly favourable.

The scheme will be in operation for an experimental period of five years. It is proposed initially to consider applications at six-monthly intervals, beginning early in 1954. Application forms will be obtainable from the Assistant Secretary, The Royal Society, Burlington House, Piccadilly, W1, and must be submitted not later than March 15 and September 15 in each year.

Pest Control

Experiments in the control of blowflies in refuse tips which have been carried out during the past year by the Pest Infestation Research Board, DSIR, England, have shown that, although synthetic insecticides prevent blowflies from emerging, an instance has been discovered of the flies developing an immunity. This is now entailing a reversion to pyrethrum mixtures.

Rural Research Centres in India

The Council of Scientific and Industrial Research in India has approved a scheme to open a series of research stations to help villagers. The "Vigyan Mandals", as they will be called, will undertake research in soil analysis and water analysis, and will also report on minor diseases.

Three stations, in Madras, Bihar and United Provinces, will be opened experimentally. If results are promising, the scheme will be expanded.

Essay Contest

The Philosophy of Science Group of the British Society for the History of Science is offering a prize of £ 50 for the best essay of not more than 4,000 words on: "What is the logical and scientific status of the concept of the temporal origin and age of the Universe?" (for example, as used in recent cosmological work). The essay should clarify the logical, theoretical and observational aspects of the idea of assigning a quantitative age to the Universe. Essays in English, French or German (in type-script) must reach the Honorary Secretary, Philosophy of Science Group, University College, Gower Street, London, W.C.1, not later than December 1, 1953, must bear a pseudonym, and be accompanied by a closed envelope containing the pseudonym and the author's name. Essays submitted will be treated as material offered to the *British Journal for the Philosophy of Science*.

Prof. T. S. Mahabale

Prof. T. S. Mahabale, who is a Vice-President of the Section of Palaeobotany, has been invited to preside over a colloquium on "The Secondary and Tertiary Floras of the Southern Hemisphere: Their Origin, Composition and Migrations", during the ensuing International Botanical Congress to be held in Paris in July 1954.

Commonwealth Bureau of Pastures and Field Crops

The Bureau which has been attached to the Welsh Plant Breeding Station, Aberystwyth, for the past 24 years will be transferred to Hurley, Berkshire, in August 1953, where it will be attached to the new Grassland Research Station, of which Dr. Wm. Davies is Director.

This Bureau, one of the 10 Commonwealth Agricultural Bureaux, was founded at Aberystwyth in 1929, its first Consultant Director being Professor, now Sir George, Stapledon. For the first 20 years of its existence the Bureau was in charge of Dr. R. O. Whyte who was succeeded as Director in 1949 by Mr. A. G. G. Hill, formerly Director of the East African Agricultural Research Institute, Amani. The Bureau issues the well-known quarterly abstract journals *Horbage Abstracts* and *Field Crop Abstracts*, in addition to its other activities.

Technical Terms in Hindi

Provisional lists of technical terms in Hindi for Secondary Schools have been prepared under the auspices of the Central Ministry of Education for five subjects: Mathematics, Physics, Chemistry, Botany and Social Sciences. The lists now being released are tentative and will be finally approved only after public comments and suggestions have been received and considered. The terms in the lists seek to meet the demands of accuracy and intelligibility as far as possible, with greater emphasis on the former wherever there has been a conflict between the two objectives. Scientific terms, which are truly international, have, however, been retained.

ERRATA

Vol. 22, page 210: In the note on 'Paper Chromatographic Separation of B-Group Vitamins', read Univ. Biochemical Lab., for Univ. Bot. Lab.

Vol. 22, page 216, column 1, line 21: In the note on 'Occurrence of *Phoma chrysanthemicola* Hollos on *Chrysanthemum* Sp.', read 138-207 $\mu \times$ 110-138 μ for 138-207 μ to 110-138 μ .

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THE PRINCIPLE OF COMPLEMENTARITY*

L. ROSENFELD

IF one wanted to condense into a pregnant formula the fundamental achievement of quantum theory, one would say that it has done away with the dualism of matter and force, which had been the *leit-motif* of scientific thinking since the days of Newton. According to quantum theory, every physical agency partakes of the properties expressed by these two concepts, and its material or dynamical aspect can, so to speak, be conjured up at will by suitably selecting the conditions of observation. Thus the same agency that usually presents itself to us as a field of electromagnetic force, spread out in space and time, can also appear in the form of a photon, *i.e.*, a quantum of energy and momentum satisfying the conservation laws in the way characteristic for material particles. Again the agency familiarly known under its aspect of material particle as

the electron has dynamical functions of essential importance, *e.g.*, in establishing molecular bonds of the homopolar type, which can only be described in terms of fields of force obeying specific wave-equations.

The integration of this new synthesis into our scientific thinking, however, raised a logical problem of a kind unprecedented in physics. It took years of hard thinking before the logical relationship between the two complementary aspects of physical reality could be completely elucidated. But the resulting doctrine, of "complementarity", elaborated by Niels Bohr, exhibits such novel features that even to-day many people are reluctant to accept it. If we try to analyse the motives for this reluctance we find that they can all be referred to a common failure to realise the dialectic movement of scientific thought. One cannot attempt to arrest this thought at any stage of its unceasing development without closing one's mind to the understanding of its further progress.

The first point to realise is that the conception of complementarity forces itself upon us with logical necessity. It arises from an effort

* Abstract of a revised version of the author's contribution entitled "L'évidence de la complémentarité", to the collective volume *Louis de Broglie, physicien et penseur* (Paris, 1952), which appeared in *Science Progress* for July 1953.

to adapt our ideas to a novel experimental situation in the realm of atomic physics. We can therefore only judge whether it adequately fulfils its function by considering it in relation to our experience and its immediate interpretation. If we consider it from the standpoint of epistemology, we may be led to modify the theory of knowledge; we cannot possibly change the lessons of experience. The latter can be embodied mathematically in the form of the well-known uncertainty relations. But the decisive step is the physical interpretation of these relations. It is at this stage that the idea of complementarity is introduced by Bohr's famous analysis. In any account of atomic processes, a restriction is imposed on the concurrent use of "conjugate" concepts, such as position and momentum, because the system under investigation interacts with the apparatus used to observe it. Owing to the quantal features of this interaction, the measurement of any quantity pertaining to the system modifies the conjugate quantity to an extent which partly escapes our control and consequently limits the possibility of defining the second quantity in the circumstances of that particular measurement. This limitation, arising as it does from the very manipulation of the measuring apparatus, is clearly inevitable.

We are thus forced to the conclusion that classical determinism has only a limited validity; this limitation of determinism is not an arbitrary decree contrary to the spirit of science, but a necessary step which opens a way for a generalisation of considerable scope. We are here witnessing with striking clarity the unfolding of a dialectic movement according to the typical scheme. The impossibility of integrating the quantum of action into the body of deterministic laws of classical physics corresponds to the phase of "negation". This phase, dominated by the contradictions of the old quantum theory, ends with the formulation of quantum mechanics and its interpretation in the frame of complementarity. This is the "synthesis" in which these contradictions vanish to make room for a new harmony.

Determinism, as a general conception of the form of natural laws, is perfectly adapted to the description of phenomena on the macroscopic scale; but the danger lies in attempting to enforce it universally. The physicist who still clings to it, who shuts his eyes to the evidence of complementarity, exchanges the rational attitude of the scientist for that of the metaphysician, who, as Engels aptly describes him, considers things "in isolation, the one after

the other and the one without the other", as if they were "fixed, rigid, given once for all". Foremost among such is David Bohm, who has attempted to supply a deterministic substratum for quantum mechanics, in which the de Broglie wave would occur only as an auxiliary concept.[†] Yet all this seductive construction is just a sham. It is Bohm's pleasure to give his "hidden parameters" such names as co-ordinate and momentum, but it is a far cry from the name to the thing. In order to be sure that such and such a parameter really represents the position of a particle, it is necessary to examine its relation to the spatial system of reference of some observer, in other words, to analyse the *measurement* of the position. But then, as one would expect and as Bohm conscientiously proves, one finds that the identification of the parameters with the corresponding physical concepts is only justified within the limits of the uncertainty relations. Thus, in the end, his subtle and laborious circuit leads us back again to complementarity.

We may thus say that the idea of complementarity succeeds in reconciling a complete objectivity of the description of natural phenomena with the necessity of taking account explicitly, in this description, of the conditions of observation. From the dialectical point of view, it is almost self-evident to observe that the essential part played by the observer in the definition of the phenomena is perfectly consonant with the fundamentally materialistic character of science. For, materialism in the scientific sense is just the philosophical expression for the process of gradual refinement of our mental representation of the external world. Trouble can only arise if materialism becomes fossilised into some metaphysical system and anything not "dreamt of in this philosophy" is branded as "idealistic".

While emphasising the universal aspect of complementarity, Bohr is more keenly aware than anyone else of the danger of treating this conception metaphysically. He insistently warns us that in the evolution of physics complementarity is just a phase which we shall soon have to leave behind us. We can already discern the limits of the domain within which one can define complementary phenomena in the sense of the uncertainty relations. The problems raised by the field of nuclear force and the various particles associated with it demand for their elucidation new methods which will very probably mean a qualitative change in our con-

[†] *Phys. Rev.*, 1952, **85**, 166, 180.

ceptions comparable to that embodied in the passage from determinism to complementarity. But just as the laws of quantal phenomena and their complementarity relationships cannot be formulated without essentially making use of the deterministic laws of classical physics, likewise complementarity will necessarily form the

basis of new conceptions which will transcend it. In generalising determinism, complementarity does not destroy it; it rather makes it more fruitful and firmer by assigning it its proper limits. Likewise the future theory will reinforce complementarity by fixing its place within a still wider synthesis.

ROCKEFELLER GRANTS FOR INDIAN INSTITUTIONS

THE following grants have been made by the Rockefeller Foundation to organisations and individuals in India in furtherance of scientific research:

Sawai Man Singh Medical College, Jaipur: \$22,345 for research equipment and facilities for breeding and maintenance of experimental animals; *Christian Medical College, Vellore*: \$10,000 for equipment and other facilities necessary for upgrading its Pathology Department; *G. S. Medical College, Bombay*: \$5,800 for equipment necessary to supply the Department of Pharmacology with minimum facilities for recognition as a Graduate Training Centre; *Dr. Jacob Chandy, Professor and Head of the Department of Neurosurgery and Neurology at Christian Medical College, Vellore*: \$4,000 to visit centres of neurosurgery and to observe new methods of medical education in Europe, the U.S.A. and Canada; *Dr. Yudhveer Sachdeva, Medical College, Amritsar*: \$4,000 to observe thoracic survey work in the U.S.A. and Canada; *Dr. S. K. Menon, Dean of the Faculty of Medicine of the University of Rajaputana and Principal of the Sawai Man Singh Medical College,*

Jaipur: \$3,575 to visit medical centres in the U.S.A. to observe methods of medical education and medical school and hospital administration; *Dr. V. S. Mangalik, Head of the Department of Pathology and Dean of the Faculty of Medicine, Lucknow Medical College*: \$3,525 to observe modern trends in medical education in Lebanon, the U.S.A. and Canada; *Dr. B. C. Bose, Professor of Pharmacology, Mahatma Gandhi Memorial Medical College, Indore*: \$3,500 to observe recent developments in the U.S.A. in pharmacology and in medical education and administration; *Indian Council of Medical Research*: \$3,500 for purchase of equipment to the G. S. Medical College, Bombay, for establishment of an experimental surgery unit under Dr. P. K. Sen, and \$2,000 for purchase of equipment for pharmacological research to one of the Medical Colleges in Madras for the use of Dr. M. N. Guruswami; *Dr. D. Narayan, Professor of Anatomy, Lucknow Medical College*: \$3,472 to observe modern trends in medical education and in anatomy research in the U.S.A. and England.

PEST INFESTATION RESEARCH AT SLOUGH

Pest Infestation Research, 1952, published recently* describes current research at the Pest Infestation Laboratory, D.S.I.R., at Slough. The laboratory is concerned mainly with the control of those insect pests which still destroy enormous quantities of the world's supply of cereal and other foodstuffs in store after harvest.

A new technique has been developed for assessing the potency of pyrethrins compared with a standard. It had been noted several years ago that flour beetles lost weight when treated with pyrethrins. This fact has now been put to use. Simply weighing a batch of beetles before and after exposure gives an accurate measure of the pyrethrin under test. The

method saves time, and eliminates the tedious work of examining and classifying each insect in a batch, as was necessary formerly. It is possible that the method will also work for other insecticides.

In the biochemistry section of the Report, special attention is given to the radioactive tracer techniques for the study of the mode of action of insecticides, in other words, how insecticides work inside the insect. Such knowledge is of the greatest importance when insects become resistant to insecticides, as house flies are becoming resistant to DDT in many parts of the world. It has been possible to show, for example, that resistant flies are able to decompose DDT in their bodies to a harmless form, an ability not shared by ordinary susceptible flies.

* Published by H.M.S.O., London, for the D.S.I.R., England, Price 2s. 1½d. by post.

NUTRITIVE VALUE OF VANASPATI

A REPORT of the work done under the auspices of the Vanaspati Research Planning Committee of the Ministry of Food, Government of India, and the Vanaspati Research Advisory Committee of the Council of Scientific and Industrial Research, has been recently issued.* A major part of this Report—Part I, covering in fact 180 pages in all,—deals with the work done under the Ministry of Food. In Part II is given an account of the work sponsored by the Council of Scientific and Industrial Research.

Part I is divided into six sections and contains in detail the results of experiments conducted according to an agreed plan, in five different laboratories in India. The results have been subjected to careful statistical analysis, a detailed account of which covers 63 pages of the report.

The origin of these scientific investigations is interesting. It lies in the undue and untimely publicity given to the results of certain incomplete investigations with the result that those who were opposed to the expansion of hydrogenated oil industry found what they believed to be scientific reasons for condemning the product as harmful to human health. A few social organizations took a hand in the campaign against "Vanaspati" without getting any authoritative scientific opinion on the matter and helped to create doubt and confusion in the minds of the consumers. The furore against vanaspati reached such a stage of intensity that the Government of India considered it necessary to step in and to order a careful scientific investigation under the auspices of their Ministry of Food.

The investigations on hydrogenated oils were undertaken, as mentioned before, in five different institutions, and included extensive experimentation on laboratory animals and on human beings as well. The work took three years to complete and the opinion of the Committee based on the conclusions drawn from experimental work are best quoted in full from the report.

"Feeding experiments with poor rice diets carried out on rats as well as on human subjects at different centres of research have not shown vanaspati of melting point 37° C. to have any deleterious effect as compared with raw and

refined groundnut oil. It appears that vanaspati of melting point 41° C. is absorbed to a lesser extent than raw groundnut oil and that it may have an adverse effect on calcium utilization, although definite conclusions cannot be drawn from the limited series of experiments on calcium metabolism. As regards comparative nutritive values of (1) pure ghee, (2) raw groundnut oil, (3) refined groundnut oil, (4) vanaspati of melting point 37° C., and (5) vanaspati of melting point 41° C., the balance of experimental evidence places ghee as the best; raw groundnut oil, refined groundnut oil and vanaspati of melting point 37° C. fall into one group and are next best to pure ghee; vanaspati of melting point 41° C. comes third in nutritive value."

The results were in no way different from those which had been reached much earlier by workers abroad. Even in India there was sufficient evidence obtained by a few scientific workers that vanaspati was harmless and that in its nutritive value it resembled the edible vegetable oils from which it was made. There was thus no need for this investigation, but owing to peculiar conditions arising out of the vanaspati controversy, the Government had to spend about Rs. 2,14,120 to prove an already proven fact.

Scientists in this country should draw a moral from this episode. They ought to be very careful when giving publicity to their results. Recent events, however, show that the lesson has not been learnt and that publicity is still valued by some more than scientific veracity. It is a sorry state of affairs and sooner it is mended the better.

A close scrutiny of the report leaves one with the impression that some of the investigations mentioned therein were unnecessary. The fact that they were undertaken contributed to the delay which occurred in completing the programme of work. In one particular investigation, certain peculiar results have been obtained, namely, the bone (femur) ash figures given on pp. 29, 38 and 44. They appear to be inordinately high, particularly those given for poor rice diets. The bone ash of rats fed adequate diets has been found to be 62 per cent. on an average; hence the observations that on poor rice diets—which are known to be deficient in calcium—higher bone ash figures were obtained makes one feel that there is something wrong somewhere.

The investigations sponsored by the Council of Scientific and Industrial Research are in a

* "Investigations on the Composition and Nutritive Value of Vanaspati."—Report issued by the Council of Scientific and Industrial Research, New Delhi, 1952.

different category. They were designed to cover a very wide field of basic and applied research in oils and fats. This will be evident from the list of problems that were taken up for investigation at the outset as detailed on p. 184. Work on some of these has been completed and fresh

problems have been undertaken. As with all researches, those on oils and fats will continue and it is expected that these will make valuable contributions to our knowledge in this particular field.

V. N. PATWARDHAN.

SOME OBSERVATIONS ON *GNETUM ULA* BRONGN. FOUND ON THE WESTERN GHATS

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GNETUM is the only gymnosperm found in the northern parts of the Western Ghats. This genus shows many interesting features resembling both Angiosperms and Gymnosperms. No work appears to have been done so far on any of the Indian species of *Gnetum* and it was thought worthwhile to study some of the important stages such as sporogenesis, male and female gametophytes, the process of fertilization and the development of the fertilized egg up to the embryo formation in one species, viz., *G. ula*.

Following are the important observations made:

(1) The microspores are arranged in a tetrad. The young microspore liberated from the mother cell has dense cytoplasm, a large nucleus with nucleolus and prominent chromatin, and a very thin wall. The first division of the nucleus results in the formation of two cells, one of which is much smaller than the other. The larger nucleus soon divides into two nuclei approximately similar in size. One of these stains feebly and is the tube nucleus while the other—rather deeply stained—is the generative nucleus. This generative nucleus is seen surrounded by a layer of cytoplasm. It is at this stage the pollen grains are shed. They show a spiny exine, a small prothallial cell, a tube nucleus and a generative cell. The further development of the gametophyte was studied both in sections of ovules and in cultures. The pollen grains germinate on the nucellus and not in the micropyle. The exine ruptures and is thrown off. The intine gives rise to the pollen tube which penetrates the papillate cells of the nucellus (Fig. 1). The pollen tubes pass through the intercellular spaces of the nucellus and many such pollen tubes have been observed in a single ovule. The small prothallial cell remains behind in the grain while the pollen tube nucleus enters the tube (Fig. 1). The generative cell soon follows and divides to form two cells which

are the male gametes (Figs. 2, 3). This division of the generative cell was seen a little away from the end of the pollen tube which was quite near the embryo-sac cell. In cultures made in 4 per cent. sugar solution, the last division was seen after about a week.

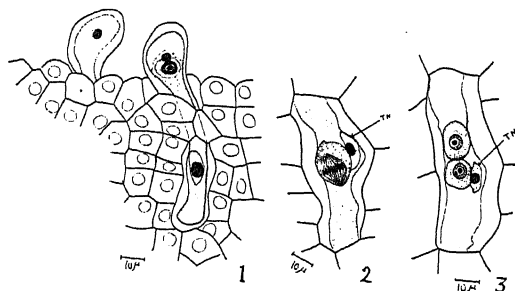


Fig. 1. L. S. of the ovule showing papillate cells of the nucellus with two pollen tubes. Figs. 2 and 3. Showing the division of the generative cell, in the pollen tube.

(2) Several radially elongated cells directly situated below the nucellar epidermis constitute the archesporium. The archesporial cells divide to form the primary parietal cells and primary sporogenous cells. The increase in the number of the parietal cells takes place by the division of the parietal cells as well as the epidermal cells. As many as twelve megaspore mother cells are seen in an ovule (Fig. 4). Out of these, generally one or two or occasionally three mother cells remain functional and undergo further development. The rest degenerate. Ultimately, only one embryo-sac develops while others gradually die out. The embryo-sac from the observations made appears to be monosporic. The functional megaspore at an early stage of development shows two vacuoles on either side at the two nucleate stage—the two nuclei being in the centre (Fig. 5). These two nuclei then move towards the two poles of the young elongated embryo sac cell and large vacuole is developed in the centre (Fig. 6).

These nuclei further divide to form a large number of nuclei of the embryo sac cell. The mature embryo sac cell is an inverted flask-shaped body with a long and narrow neck. The number of nuclei in this sac is very large—exceeding a thousand. The actual number counted is 634 out of which some were in prophase and some in metaphase stage. The egg nucleus is

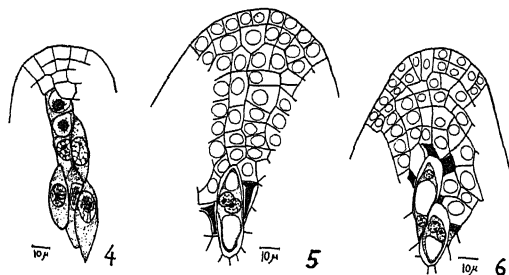
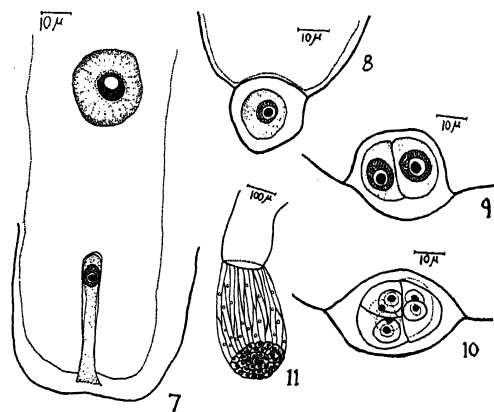


Fig. 4. L. S. of the ovule showing a few megaspore mother cells. Fig. 5. L. S. of the ovule showing embryo sac cell with two nuclei in the centre and vacuoles towards the poles. Fig. 6. L. S. of the ovule showing embryo sac cell with vacuole in the centre and the two nuclei at the two poles.

not prominently differentiated. It may be pointed out that according to Fagerlind,¹ the embryo sac cell in *Gnetum gnemon ovalifolia* is tetrasporic. All the megaspore mother-cells show at the four-nucleate stage four nuclei in the centre with vacuoles towards the periphery. At the two-nucleate stage and even before the formation of four-nucleate condition no vacuoles were seen developed. The observations made by us in *Gnetum ula* Brongn., as can be seen from the above description, appear to be quite different.

(3) Before the process of fertilization, the endosperm tissue begins to be differentiated. Cell-walls are laid down in the lower part of the embryo sac, each cell enclosing many nuclei. Walls are also laid down in the upper part—particularly towards the periphery—with the result that a large space with many free nuclei is seen in the centre. At this stage, the egg nucleus with a dense mass of cytoplasm and a male gamete nearby is observed enclosed in a wall. The nuclei fuse and a prominent fertilized egg is observed. It may be pointed out that in some ovules more than one oospore were observed. The oospore nucleus divides to form two cells. These further divide and give rise to an irregular multicellular structure from which are formed a large number of suspensor

tubes which ultimately penetrate the endosperm tissue. The number of the suspensors varies from a few to more than a dozen. Each suspensor has a single nucleus and dense mass of cytoplasm towards the tip. The suspensors grow together like a long, coiled structure and often measure upto 7 cm. The nucleus of the suspensor tube divides to form two nuclei, one of which remains in the suspensor, while the second is cut off to form a small cell at the tip (Fig. 7). This cell is gradually pushed out and finally is separated from the suspensor protoplasm, but remains within the wall of the suspensor (Fig. 8). It divides vertically into two (Fig. 9), and then into four cells. These four cells divide transversely (Fig. 10). Further



Figs. 7 to 11. Showing early stages of development of an embryo.

divisions take place rather irregularly. The cells towards the suspensor become elongated and form a multicellular secondary suspensor, while the cells towards the tip develop into the embryo proper. The secondary multicellular suspensor is seen attached to the end of the primary suspensor tube (Fig. 11). In the beginning, two cotyledons surrounding a conical projection are seen differentiated at the apex. A little later, the root initial is also differentiated internally towards the suspensor. The feeder soon develops as a lateral outgrowth from the hypocotyle region. Feeder is flat in the beginning, but soon assumes a cylindrical form. To start with, many embryos are seen developing, but ultimately, only one attains maturity.

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BETTER RESOLUTION BY USING
SUITABLE APERTURES

WILLIAMS¹ has suggested the use of a suitable aperture with Lummer Gehrcke Plate for improvement in resolution at the expense of slight loss of intensity. He made use of the fact that resolution, obtained with N beams of equal intensity is greater than that obtained with N beams of slowly diminishing intensity. The nearer the beams are to equality, the greater is the resolution. Williams proposed placing a trapezium-shaped aperture over the plate-surface for the purpose. The increase in width of the emergent beam compensates for the loss in intensity due to successive reflections and absorptions in the plate.

The emergent beam system² in Lummer Gehrcke plate consists of $N (= 1/2t \tan r)$ interfering beams of intensities $I_0 a^{2(N-1)}$, $I_0 a^{2(N-2)}$, $I_0 a^2$ and I_0 ($a = \text{Re}^{-kt \sin r}$) emerging from points on the plate with a constant separation $d (= 2t \tan r)$. In order to obtain maximum possible resolution from the instrument, we should make the intensities of all the beams equal by placing a suitable aperture over the plate-surface. The condition for this is that the ratio of the widths of the aperture at any two points separated by a distance d is the same namely, a^2 . The condition is not fulfilled by Williams' trapezium-shaped aperture, as is easily seen.

The author suggests the use of two types of apertures to achieve this as shown in Figs. 1

and 2. Fig. 1 is self-explanatory. The equation to the aperture with curved boundary

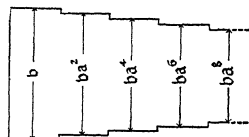


FIG. 1

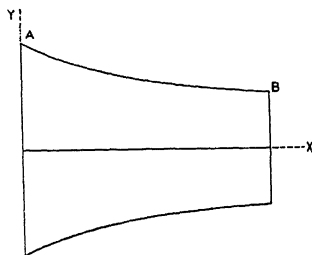


FIG. 2

(shown in Fig. 2) is $y = f(x)$, where $f(x)$ is the solution of the equation :

$$\frac{f(x+d/2)}{f(x-d/2)} = a^2$$

The solution, satisfying the boundary condition $y = b/2$ at $x = 0$, is :

$$y = (b/2) a^{2x/d} \quad (1)$$

The intensity patterns without and with the suggested apertures are given by :

$$I = \frac{I_0 \{ (1-a^N)^2 + 4a^N \sin^2(N\beta) \}}{\{ (1-a)^2 + 4a \sin^2 \beta \}} \quad (2)$$

and

$$I' = \frac{I_0 a^{2(N-1)} \sin^2(N\beta)}{\sin^2 \beta} \quad (3)$$

The principal maxima in the two cases have the intensities :

$$I_{max} = \frac{I_0 (1-a^N)^2}{(1-a)^2} \quad (4)$$

and

$$I'_{max} = I_0 a^{2(N-1)} N^2 \quad (5)$$

The resolving powers in the two cases are :

$$R = N_e R_0 \quad (6)$$

and

$$R' = N R_0 \quad (7)$$

where $R_0 = \{m - (2t/\cos r) (d\mu/d\lambda)\}$, m being the order of the fringe. Curves giving the values of N_e for various values of N and a have been given by Candler.³

N_e is always less than N and it is clear that the use of an aperture of the above shape increases the resolving power.

Recently, Sodha⁴ has shown that the emergent beam system from a transmission echelon is similar to that from a Lummer Gehreke Plate

except that $a^2 = e^{-kt}$, t being the height of a step and k the absorption coefficient for intensity. So, in this case also similar apertures will be useful. Equations (4) to (7) will be true except that $R_0 = (m - t d\mu/d\lambda)$, where m is the order of the fringe.

The author acknowledges thanks to Dr. K. Majumdar, Dr. Y. P. Varshni, Dr. D. Sharma and Prof. B. K. Agarwal for their kind interest in the investigation.

Dept. of Physics, MAHENDRA SINGH SODHA,*
Allahabad University,
Allahabad, March 10, 1953.

1. Williams, *Personal Communication in High Resolution Spectroscopy*, 1947 (Methuen & Co., London) p. 209.
2. Sodha, *Jour. Sc. Ind. Res.*, 1952, **11B**, 395.
3. Candler, *Modern Interferometers* (Hilger & Watts, London), 1949, p. 339.
4. Sodha, *Sc. and Cult.*, 1953, **18**, 489.

* Now at Defence Science Laboratory, New Delhi.

STUDIES OF SAND MOVEMENT ACROSS THE WALTAIR BEACH

In connection with the extensive Oceanographic Programme now being carried on by the Andhra University, studies of sand movement on the Waltair Beach have been in progress since December 1952. The preliminary results of the study presented here deal with the movement of sand in the intertidal zone.

With data obtained from repeated measurements of profiles of the beach, the concentration of black sand, compaction of the sand, waves, current and especially tide range, several comparisons were made and cycles established. The foreshore is usually eroded during spring tides and the eroded sand is deposited on the lower foreshore and offshore. The cycle in sand level is completed when, in periods of neap tide, the sand is returned up the beach to approximately its former level. The main difference in environmental conditions, aside from the height of water during spring and neap tide are (1) the relative time that any vertical level of beach is washed by the waves, and (2) the character of waves caused by the difference in water depth. By calculating the washed zones it was found that spring tides produce two zones of long duration wash, while neap tides produce only one. This is believed to be a major factor in the sand movement from one level to another on the beach.

The wave energy at low tides is believed to be dissipated over the long shallow offshore

area, whereas at high tide, the energy is expended at a local zone high on the foreshore. Thus, the sand movements in various zones of the beach are largely related to the tide range.

The compaction of sand on the foreshore just above mean tide level during periods of deposition is less than it is during periods of erosion. Further, the heavy black sand concentrates appear to be moved on the beach in cycles related to the sand level. Its appearance is probably due to the panning action or erosional concentration of waves when the beach undergoes major cuts. The heaviest concentration of the black sand is on the upper foreshore.

A detailed paper embodying these results is under publication in the *Memoirs of the Andhra University—Oceanography*, Part I.

Andhra University, E. C. LA FOND.
Waltair, June 5, 1953. R. PRASADA RAO.

EXTRACTIVES FROM SOUTH ARCOT LIGNITE

SOUTH ARCOT lignite¹ yields montan wax, an ester wax extracted by solvents from certain types of lignite. Chandra² extracted a sample of "Cuddalore lignite" with benzene, petroleum and chloroform and his reported yields of extractives are low. In the present investigation, ten samples of South Arcot lignite were extracted with benzene and xylene and the yield of raw wax (which is generally a mixture of wax and resin) compared with yields from foreign lignites.

Every sample of lignite is first air-dried and about 20-30 g. of the material were extracted with the solvent in a soxhlet apparatus until the solvent in contact with the lignite was colourless. The solvent was distilled off and the yield of wax determined. A composite sample of the wax material was used for the determination of the melting point and the ash content.

Table I gives the yield of raw wax.

The data indicate that the yield of extractives are higher with xylene than with benzene and is dependent on the nature of the lignite, it being higher where the volatile matter in the lignite is higher.

The wax was a hard and brittle material with a dark brown colour. It was partially soluble in alcohol and ether. The melting point of benzene extractives was 83-84° C. and that of xylene extractives, 81-82° C. The ash content of the former was 0.25 per cent., while that of the latter, 0.23 per cent.

The yield of benzene extractive from South Arcot lignite (percentage by weight of mois-

TABLE I.
YIELD OF EXTRACTIVES
Summary of results on ten samples of South Arcot lignite

| Vol. matter | Fixed carbon | Extractives with benzene | | | Extractives with xylene | | |
|-------------|--------------|------------------------------------------|----------------|----------------|-------------------------|----------------|----------------|
| | | percentage (moisture and ash-free basis) | percentage (1) | percentage (2) | percentage (1) | percentage (2) | percentage (3) |
| 52.3 | 30.5 | 0.99 | 1.30 | 1.41 | 1.95 | 2.32 | 2.49 |
| to | to | to | to | to | to | to | to |
| 69.5 | 47.7 | 9.95 | 10.88 | 11.36 | 11.14 | 12.17 | 12.72 |

1. By weight of lignite. 2. By weight of moisture free lignite. 3. By weight of moisture and ash-free lignite.

ture-free lignite) compares favourably with yields from Devon lignite,³ 3.0 to 5.0 per cent., Texas lignite,⁴ 1.5 to 2.4 per cent., North Dakota lignite,⁴ 1.2 to 1.6 per cent., California lignite,⁴ 6.6 to 7.1 per cent. and German lignite,⁵ 10 to 15 per cent.

Not all samples of South Arcot lignite give high wax yields. A selection based upon the analysis of the raw lignite would be necessary for obtaining the best lignites for wax extraction.

We thank the Government of Madras for permitting the publication of these results, and Dr. Paul R. Eyrich and Mr. H. K. Ghose for their interest in the progress of this work.

Lignite Investigation Lab., C. V. S. RATNAM.
Govt. of Madras, Neyveli, S. VEERARAGHAVAN.
June 30, 1953.

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AMMONIUM SULPHATE AS A FLUX FOR ILMENITE

AMMONIUM SULPHATE, when heated to its melting point, 150° C., decomposes slowly upto 340° C. into ammonia and ammonium bisulphate. On fusion with any basic oxide, it loses ammonia in common with other ammonium salts, transferring its acid part to the new base. The

formation of the acid sulphate by heating the neutral salt indicated, therefore, that it may be used in place of sulphuric acid or sodium and potassium bisulphates to open up ilmenite and other ores.

Ilmenite sand from Travancore was finely crushed and levigated. The levigated ore was mixed with varying quantities of $(\text{NH}_4)_2\text{SO}_4$ and Na_2SO_4 and the mixture was ignited in a silica crucible at about $300\text{--}340^\circ\text{C}$, till the evolution of NH_3 was complete and the fused mass started giving white fumes. The cooled mass was extracted with acidulated water (H_2SO_4) and filtered. The filtrate was preserved and the residue was ignited to constant weight.

The difference in the weight of the sample and its residue was taken as a measure of the extent of the reaction.

The following table gives the quantitative details of the experiment:—

| Expt. | Ilmenite | Ammonium sulphate | Sodium sulphate | Residue | Extraction % | Ore: $(\text{NH}_4)_2\text{SO}_4$ |
|-------|----------|-------------------|-----------------|---------|--------------|-----------------------------------|
| 1 | 0.1530 | 0.4 | 2.5 | 0.0872 | 40.3 | 1 : 3 |
| 2 | 0.1466 | 0.4 | 2.5 | 0.0894 | 40 | |
| 3 | 0.1592 | 0.4 | 2.5 | 0.1026 | 36 | |
| 4 | 0.1472 | 0.6 | 2.5 | 0.0526 | 64 | 1 : 4.5 |
| 5 | 0.1453 | 0.6 | 2.5 | 0.0480 | 67 | |
| 6 | 0.1502 | 0.8 | 2.5 | 0.0270 | 80.2 | |
| 7 | 0.1528 | 0.8 | 2.5 | 0.0310 | 80 | 1 : 6 |
| 8 | 0.2522 | 1.6 | 3.5 | 0.0408 | 84 | |

Higher proportions of ammonium sulphate did not yield better results. Extension of these observations to other ores is under investigation. Grateful thanks are due to Prof. S. S. Joshi for his advice and guidance.

Banaras Hindu University, D. K. PATWARDHAN.
May 1, 1953. G. S. DESHMUKH.

RAPID ESTIMATION OF YIELD AND IODINE VALUE OF OIL IN SMALL SAMPLES OF OILSEEDS

In continuation of earlier studies,¹ a method has now been worked out to determine both yield and iodine value of an oil with 0.3 to 0.5 g. of seeds in about 1.5 to 2 hours, using carbon tetrachloride as solvent. The procedure adopted is as follows:—The weighed sample (0.3–0.5 g.) is ground with 2–3 g. of anhydrous sodium sulphate and 2 g. glass powder (pyrex glass, washed with hydrochloric acid) in a mor-

tar, transferred to a 50 ml. Erlenmeyer flask with 8–10 ml. of carbon tetrachloride, refluxed for 3 to 4 minutes and after cooling, filtered through a sintered glass funnel into a 25 ml. graduated flask. The flask and residue are washed with small amounts of the solvent till the total filtrate is about 20–22 ml. This is then made up to volume. 5 ml. aliquots are evaporated in crucibles or flat dishes in a vacuum oven at 100°C . for one hour or till constant weight is reached, and from the weight of the residue the oil content is calculated.

To determine the iodine value of the oil extracted, 5 ml. aliquots of the solution (weight of oil in 5 ml. of the solution determined as aforesaid), are pipetted out into iodine value flasks, 10 ml. of Hanus' solution added and the determination conducted as usual, the only alteration introduced being the use of N/20 instead of N/10 sodium thiosulphate solution.

Experiments were conducted with linseed (4 different varieties), safflower seed, *Brassica campestris* seed, tobacco seed, poppy seed, groundnut, mustard seed and til seed. In the case of linseed, the time of reaction for iodine value determination had to be increased to two hours; in all other cases, the usual half-hour period was found sufficient.

In all the above cases, the yield of oil using carbon tetrachloride as solvent was the same as when benzene was used. The iodine value of the oil determined according to the present method agreed with that determined by conventional procedures on the oil expressed from the seeds to within one unit. Fuller details will be published elsewhere.

Thanks are due to the Indian Central Oil Seeds Committee for enabling one of us (A. S. S.) to take part in the investigations, and for permission to publish the results.

Indian Agric. Res. Inst.,
New Delhi,
March 15, 1953.

A. S. SETHI.
A. R. S. KARTHA.
K. C. GULATI.

I. Chopra, I., Sehgal, R. G., Chatterjee, B. G., Bose, A. C., and Gulati, K. C., *Indian J. Agric. Sci.*, 1952, 22 (II), 183.

ORBITOIDS FROM THE CRETACEOUS ROCKS NEAR ARIYALUR (S. INDIA)

SINCE reporting recently (*Current Science*, March 1953), the occurrence of a rich foraminiferal fauna dominated by the Orbitoids in some of the sandstones near Ariyalur, several sections of these rocks have now been looked into for the study of their foraminiferal contents, especially the Orbitoids. From this general and

preliminary examination, it would appear that there are four types of Orbitoids commonly found here. The following short notes, with the illustrative microphotographs (Figs. 1-4), will serve to give a general idea of each of these types.

conch is not clearly preserved; the nature and arrangement of the lateral chambers very clearly seen; the form appears to be slightly asymmetrical. Length: 2.496 mm. Breadth: 0.720 mm. The general shape of the form is quite distinct.

Fig. 3 shows a tangential section; the com-



FIG. 1, $\times 64$

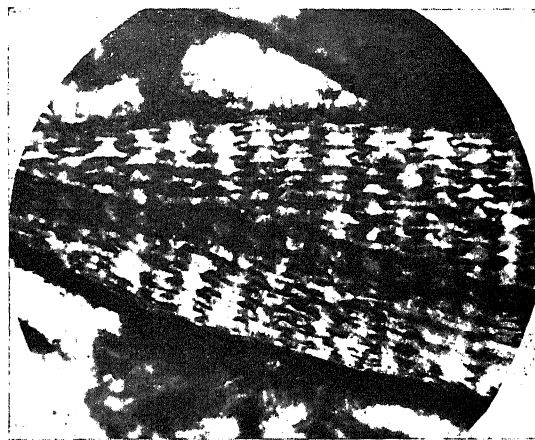


FIG. 3, $\times 80$



FIG. 2, $\times 30$

Fig. 1 shows an oblique tangential section; the complete form is seen in the slide, but only a part has been shown in the photograph. Length: 2.400 mm. Breadth: 0.720 mm. The form is tapering only very slightly, the breadth being practically the same throughout. Nature and arrangement of the chambers clearly seen; but the orientation of the section in the lower half is not the same as in the upper. Chamber roofs cribriform; stoloniferous apertures noticed.

Fig. 2 shows a fine section which appears to be truly axial; but the region of the nucleo-



FIG. 4, $\times 90$

plete form (seen in the slide) is elongated and gradually tapering. Length: 2.784 mm. Breadth: 0.480 mm. Equatorial chamber walls thick and prominent; outline of chambers squarish, slightly oblong, or diamond-shaped. Lateral chambers in tiers, 9 or 10 in the centre, and reduced to 3 or 4 towards the periphery.

Fig. 4. A true vertical section showing the nucleoconch. The full form is seen in the slide, and is very well preserved. Length 2.016 mm. Breadth: 0.538 mm. Form slightly asymmetrical, being more convex on one side than on the other. The most interesting feature is the

bilocular nucleococonch with two large sub-equal chambers separated by a straight wall. The two chambers of the nucleococonch are enclosed by a thick wall, well seen in the photograph. The outlines of the two chambers are well defined and sharp. This type of nucleococonch suggests a lepidocyclone(?) feature. An equatorial section with the chambers would be necessary in fixing up this identity; but no such clear section has yet been available.

Generally speaking, it is seen that many of the slides are full of Orbitoids; and though the sections are often partial and incomplete, some show quite clearly the shape and arrangement of the chambers, structure of the chamber walls, nature of the stolon system, etc. These have been compared with the other Cretaceous Orbitoids already described from India, notably by Vredenburg (1908), Douville (1916), and more recently by S. R. N. Rao (1941) from this very area. None of the forms now under study has been named as yet; for that requires more elaborate comparisons and measurements based on the study of properly oriented sections, especially equatorial. But even at this stage it seems reasonable to indicate that many of the forms found here appear to be new, at least so far as India is concerned in the sense that they have not been noticed before.

In addition to these Orbitoids, a number of other Foraminifers are also represented in these rocks; particularly striking are some forms which look like true Nummulites, but very small; and others which are probably Ammibaculites (?). Siderolites, is also there.* It is specially interesting to note that in a general survey of this entire foraminiferal assemblage, we see now and again indications of a distinct early Tertiary (Paleocene?) touch. *Prima facie*, these beds would of course be considered, from their position in the field, as part of the Upper Ariyalurs, Maastrichtian in age; and the general nature of the Orbitoids would seem to support this view; but what the entire assemblage would ultimately mean, on fuller study, remains to be seen. The whole material is certainly of outstanding interest, and it will naturally take some time before it is all properly worked out.

This is being done and a fuller paper will soon be published elsewhere.

Bangalore, L. RAMA RAO.
July 22, 1953.

*Since writing the above, more sections of these rocks have been prepared and examined; and it is seen that some of them reveal the

abundant occurrence of *Siderolites* most beautifully preserved. In view of the fact that *Siderolites* is such an interesting genus, and we know at present so little of this form in India, the present find promises to be specially valuable. A note on this subject will be published shortly.

September 3, 1953.

L. RAMA RAO.

ARTIFICIAL PRODUCTION OF TETRAPLOIDS IN *RICINUS* *COMMUNIS* LINN.

AN effort was made to induce polyploidy in castor (*Ricinus communis* Linn.) at Government Agricultural College, Kanpur, during 1949-50. Solutions of colchicine, having concentrations ranging from 0.1-0.5 per cent. were used for inducing polyploids. Both apical meristematic region of plants and germinating seeds were tried.

It was found that 0.3 per cent. of colchicine solution gives successful results in induction of polyploid in the apical meristem and germinating seeds. For both the cases, there was no effect with lesser concentrations, while with greater concentrations, all the shoots died. The tetraploid so obtained was studied with diploid in relation to number of chromosomes, size of pollens, stomata, cotyledonary leaves and seeds. The arrangement of the chromosomes is presented in Plate I.



Anaphase II Polar view showing 40 distribution, Polyploid.

Metaphase I Polar view showing 10 distribution, Diploid.

During March and April 1950, between 9 and 10 a.m., male buds were fixed in acetic alcohol (1:3) and then changed to 70 per cent. alcohol after 24 hours. Stamens were smeared on slides

in acetocarmine and then the preparations were made permanent for cytological studies by McClintock's method. Pollens were also stained by acetocarmine in a grooved slide and made permanent as above. The lower epidermis of polyploid and diploid leaves were teased, stained with fast green and made permanent for stomatal studies.

The author is very grateful to Prof. K. N. Kaul for valuable guidance in the work.

Agricultural Officer, ANUBHAVA NARAIN.
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April 1953.

INFLUENCE OF FORMIC ACID ON THE HYDROLYSIS OF TISSUE (LIVER) PROTEINS

THE present methods of hydrolysing the tissue proteins with concentrated acid or alkali suffer from two handicaps: (1) They are time-consuming, often requiring 6-24 hours of refluxing with concentrated acid or alkali, and (2) they cause a loss of some of the amino acids due to destruction or deamination.^{4,6,9} Other acids² including formic acid^{3,7} have also been advocated for the hydrolysis of proteins, but none of these had any definitely established advantage except possibly when it is desired to isolate a particular amino acid. Considerations of structural factors, such as the steric hindrance to the approach of water molecules preparatory to hydrolysis of peptide bond⁵ and the knowledge that formic acid transforms the folded polypeptide chains into the easily accessible extended peptide chains¹ led us to study the rate of hydrolysis of tissue proteins with HCl, after the tissue had been treated with formic acid. It is this aspect of the investigation that is being reported here.

Fresh liver tissue obtained from slaughter house were used in all the experiments reported here. For every gramme of the liver tissue taken, 5 ml. of 85 per cent. formic acid is added and heated to boiling. The tissue goes into solution immediately after boiling. The rates of hydrolysis of this formic-acid-treated tissue material is then studied using 6N, 4N and 2N hydrochloric acid. Samples were withdrawn from the refluxion mixture at 15 minutes interval, cooled to room temperature and the amino acids liberated determined by the formol titration technique.⁸ Qualitative biuret tests were also carried out on each of the samples to determine the presence of peptide bonds in the sample. The hydrolysis was continued till

the biuret test became negative and the amino acid titre remained constant. The results with 2N HCl are given in Fig. 1. Similar curves were obtained with 6N and 4N HCl. The hydrolysis time for the formic-acid-treated tissue with 6N HCl was 45 minutes whereas that of untreated tissue was 60 minutes. The corresponding figures with 4N HCl were 75 and 105 minutes respectively.

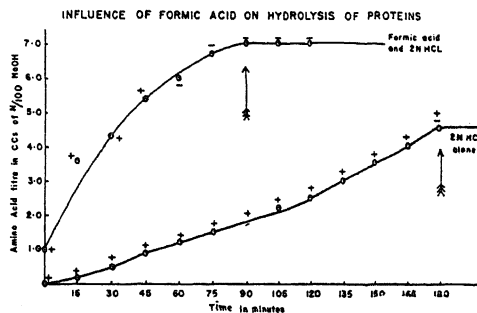


FIG. 1. Progress of hydrolysis with 2 N HCl

+ Biuret test positive — Biuret test negative

In one experiment, the progress of hydrolytic effect of formic acid alone, without the subsequent addition of HCl was studied. The tissue proteins remained practically unaffected even after two hours of refluxing.

To test the efficacy of the method, various amino acids, such as glycine, tryptophane, glutamic acid, cystine, leucine, lysine and phenylalanine were subjected to formic acid treatment followed by 1 hour refluxing with 6N, 4N and 2N HCl. Pure amino acids were used for this purpose and amount of amino acid remaining in the hydrolysate after refluxing was determined by the formol titration method. The proportion of formic acid and the strengths of acid used was the same as used in the hydrolysis of tissue proteins. The recoveries of individual amino acids are given in Table I.

The influence of formic acid on the hydrolysis of different proteins, such as casein and gelatin was also studied. But the rates of hydrolysis of casein and gelatin were not in any way altered by the treatment with formic acid prior to acid hydrolysis.

It was found that though formic acid treatment prior to acid hydrolysis did not in any way influence the rate of hydrolysis of casein and gelatin, it did reduce the hydrolysis time considerably when the liver tissue was treated with formic acid prior to hydrochloric acid hydrolysis. The results were very much more

marked with 2 N HCl. In this case, the liver hydrolysate showed a positive biuret test three hours after refluxing with 2 N HCl alone, whereas the formic acid treated tissue was completely hydrolysed in 90 minutes time. These results show very clearly that formic acid treatment prior to acid hydrolysis does facilitate hydrolysis.

TABLE I

Recovery of amino acids subjected to formic acid-hydrochloric acid hydrolysis

| Name of amino acids | Percentage recovery of amino acids after one hour refluxing with formic acid and HCl | | |
|---------------------|--------------------------------------------------------------------------------------|-----------------------|-----------------------|
| | Formic acid + 6 N HCl | Formic acid + 4 N HCl | Formic acid + 4 N HCl |
| Glycine | 98.9 | 99.0 | 99.0 |
| Tryptophane | 98.5 | 98.5 | 98.5 |
| Glutamic acid | 94.0 | 94.0 | 94.0 |
| Cystine | 95.9 | 95.9 | 95.9 |
| Leucine | 98.0 | 98.0 | 98.0 |
| Lysine | 99.7 | 99.7 | 99.7 |
| Phenylalanine | 99.0 | 99.0 | 99.0 |

The new procedure has, therefore, a double advantage. It not only curtails the time of hydrolysis, but also protects the amino acids, which are normally destroyed during the acid hydrolysis, due to oxidative degradations. This may probably be due to reducing properties of formic acid by virtue of its CHO group in the molecule.

The authors wish to thank Dr. V. R. Khanolkar for his kind interest in the work.

Indian Cancer Res. Centre,
Parel, Bombay,
May 26, 1953.

S. U. GURNANI.
M. B. SAHASRABUDHE.

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ASSOCIATION OF CHANGE IN PHYLLOTAXY WITH THE OCCURRENCE OF TRICOTYLY IN ANTIRRHINUM MAJUS AND ZINNIA PERUVIANA

TRICOTYLEDONOUS seedlings occasionally occur in nurseries of dicot plants. Tricotyly seems to be associated with the change of phyllotaxy (i.e., the orientation of the leaves on the stem) as observed in two species of ornamental plants.

(1) *Antirrhinum majus* (Family—Scrophulariaceae.)

Snapdragon, as it is commonly called, is a floral herb and is renowned as an ornamental plant. Normally (in dicotyledonous seedlings), the leaves are arranged in the main axis in opposite and decussate fashion. But, in this tricotyledonous plant, the leaves were verticillate with three at each node. The internodal length between the dicot and the tricot remained the same. The size and the shape of the leaves did not differ. The height of the tricot plant was nearly the same as that of the dicot plant as the former measured 45.5 cm. and the latter 44.0 cm. The axillary shoots, however, did not show the verticillate arrangement of the leaves, but had the same nature of phyllotaxy as that of the dicot sib.

The inflorescence or the flower was not much different from that of the dicot, but the pollen sterility in the tricot anthers was 90 per cent. No seeds could be obtained by either selfing or reciprocal crossing with the dicot.

(2) *Zinnia peruviana* (Family—Compositae).

It is an annual, floral herb with simple connate leaves arranged in an opposite and decussate manner in the dicot plants. But, in the tricot, the leaves were arranged spirally such that every sixth leaf on the axis was exactly over the first leaf and for reaching the sixth leaf from the first, one has to make two circles round the stem. The angle of divergence, therefore, equals $2/5 \times 360^\circ$, i.e., 144° .¹ It might, however, be noted that the axillary shoots had opposite and decussate leaves like the dicot sib. The main axis of the tricot presented a twisted appearance. Further, the shape of the leaf was affected in the tricot. The leaves were simple and sessile instead of being connate (i.e., the two leaf-bases together encircling the node). The height of the tricot was 53.5 cm. and that of the dicot was 50.0 cm., thus showing no appreciable difference.

In the tricot, 95 per cent. of the pollen grains were sterile and no seeds could be obtained by

either selfing or reciprocal crossing with the dicot.

Central Rice Res. Institute,
Cuttack-4, Orissa,
June 5, 1953.

B. MISRO.

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EFFECT OF NITROGENOUS FERTILIZATION ON THE INCIDENCE OF 'BLAST' ON RICE VARIETIES

THE following nine varieties, Co.4, T.141, T.608, GEB.24, T.1145, BAM.5, Co.3, ASD.1, Co.13, were used in a test to see how rice varieties react to blast (foliar infection) under different levels of N fertilization. The experimental unit was 25 seedlings of a variety growing in five pots—at the rate of 5 seedlings per pot, for each level of N tested. N was applied in the form of ammonium sulphate solution when the seedlings were a fortnight old to give approximately 20, 40, 60, 80 and 100 lb. of N per acre. A set of 25 seedlings was left unfertilized to serve as a control in each variety. A week after the application of the fertilizer, the seedlings were infected with a spore suspension of *Piricularia oryzae*. The degree of infection which developed on the seedlings was scored 7 days later according to the standard method used at the Central Rice Research Institute.

The infection scores were analysed statistically and the results are presented in Table I below.

B. Average infection score of each variety under different levels of N fertilization

| Level of N, lb. per acre → | | 0 | 20 | 40 | 60 | 80 | 100 | Mean |
|----------------------------|----|------|-------|--------|--------|--------|--------|--------|
| Variety | | | | | | | | |
| T. 141 | .. | 1.92 | 8.64 | 10.30 | 21.20 | 129.60 | 110.60 | 47.04 |
| T. 608 | .. | 1.80 | 3.60 | 22.24 | 18.48 | 19.44 | 57.46 | 20.50 |
| CO. 4 | . | 2.28 | 1.76 | 2.02 | 3.10 | 3.64 | 4.60 | 2.90 |
| GEB. 24 | .. | 4.44 | 11.66 | 32.52 | 40.48 | 53.28 | 71.52 | 35.65 |
| T. 1145 | .. | 3.00 | 7.80 | 36.16 | 38.56 | 57.76 | 65.16 | 34.74 |
| BAM 5 | .. | 2.16 | 8.92 | 44.40 | 86.72 | 103.84 | 45.60 | 48.67 |
| CO. 13 | .. | 1.96 | 46.32 | 117.20 | 138.58 | 157.00 | 147.84 | 101.48 |
| ASD. 1 | .. | 2.84 | 18.42 | 37.68 | 109.04 | 120.58 | 133.28 | 70.31 |
| CO. 3 | .. | 1.58 | 23.64 | 38.42 | 79.90 | 50.44 | 47.82 | 40.30 |
| Mean | .. | 2.44 | 14.53 | 37.93 | 59.56 | 77.19 | 75.99 | |

S.E. of treatment Mean = 1.97; C.D. = 6.23

S.E. of varietal Mean = 1.97; C.D. = 7.63

S.E. of individual Mean = 6.71; C.D. = 18.68

The varietal and nitrogen treatments as well as the varietal \times N interaction were highly significant. The increase in leaf infection of blast in rice with increase in level of N application varied significantly between varieties. For instance, there was practically no increase in infection in Co.4, over the 6 levels of N, while in Co.13, the amount of infection increased steeply with each increase in level up to 80 lb. The reaction of the other varieties lay between these two extremes. Similar results have been reported for "neck infection" in blast between Co.4 and ADT.10.¹

On account of the differential reaction of varieties to blast under different levels of N fertilization, it is desirable that artificial infection tests are carried out under a standardised

TABLE I
DIFFERENTIAL REACTIONS OF VARIETIES TO BLAST
INCIDENCE UNDER GRADED LEVELS OF
N FERTILIZATION
A. Analysis of variance

| Source | Degrees of freedom | Sum of squares | Mean sum of squares | Fk* |
|------------------------------------|--------------------|----------------|---------------------|--------|
| Nitrogen levels (N) | 5 | 170441.49 | 34088.30 | 151.68 |
| Varieties (V) | 8 | 215733.44 | 26966.68 | 119.95 |
| Interaction V \times N | 40 | 113127.16 | 2828.18 | 12.58 |
| Remainder (pots within treatments) | 216 | 48561.02 | 224.82 | |
| Total | 269 | 547863.11 | | |

* Significant at 1% level.

N level, so that any two tests are comparable. For purposes of recommending varieties as 'resistant' for general cultivation, it is suggested that the tests may be conducted at 40 lb. N per acre in India, as this represents the optimum economic level of N for this country and is widely recommended as such. However, in order to pick out the more highly resistant varieties, which may be used as parents in hybridization, it would be useful to have the tests at 100 lb. N per acre.

The author is indebted to Shri K. Ramiah for his keen interest in the study, and to Dr. N. Parthasarathy for his critical suggestions and help in the preparation of the manuscript.

Central Rice Res. Inst., S. Y. PADMANABHAN.
Cuttack, June 6, 1953.

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PHOTOPERIODIC BEHAVIOUR OF CERTAIN VARIETIES OF RICE

THIRTY days' old seedlings of *Oryza sativa* were given short-day treatment of 8 hours' duration (7 a.m. to 3 p.m.) for 20 days. They came to head within 60-80 days after sowing.

(i) With GEB. 24, a variety from Madras (flowering time: 145 days), the following results were obtained (Table I).

TABLE I

| Time of sowing | Mean interval between flowering and sowing | | Photoperiodic response |
|----------------|-----------------------------------------------|---------|---------------------------|
| | Treated | Control | |
| 21-4-52 | 58.0 | 185.0 | 127.0 |
| 26-6-52 | 65.4 | 145.5 | 80.1 |
| 19-7-52 | 67.7 | 106.0 | 38.3 |
| 30-8-52 | 77.3 | 105.4 | 28.1 |

As the date of sowing approaches the normal season of flowering, the margin of response gets narrower and narrower; it gets reduced from 127 days to 28.1 days, i.e., it behaves as a season-bound variety.

When seeds of GEB. 24 were sown on 27-10-1951, the flowering occurred within 150 days, i.e., in both the years, towards the end of March, when the days get longer. It no longer functions as a season-bound variety. From this behaviour, one would perhaps group the variety as a long-day plant. But long-day

treatment did not cause any early flowering and it cannot be strictly called a long-day plant.

Thus, GEB. 24 behaves neither as a typical long-day nor as a typical short-day plant, and may, therefore, be classified into an "intermediate" group.

(ii) Seeds of Baok¹ were sown in 8 pots on 26-12-1952, and five plants were retained in each. Three pots were given short-day treatment of 8 hours daily for 20 days to seedlings of age 14, 21 and 28 days respectively. Another set of three pots of corresponding age was subjected to long-day treatment by exposing throughout the night to 500 watt electric light for 20 days. Two pots were retained as control. The results are indicated in Table II.

TABLE II

| Age of the seedlings in days when treated | Nature of photoperiodic treatment | |
|----------------------------------------------|--------------------------------------|-----------------------|
| | Short-day treatment | Long-day treatment |
| 14 | 128.5 | 127.3 |
| 21 | 141.0 | 133.3 |
| 28 | 138.2 | 136.7 |
| Control | 144 | .. |

It can be seen that there is response to both short-day and long-day treatment when 14 days' old seedlings were treated. Baok falls into a distinct group of its own. The age of the seedlings at which it is subjected to photoperiod treatment is also important, and this is more clearly illustrated below.

(iii) Two improved strains (T.90 and T.1242) procured from the Orissa Agricultural Department did not show any response to the usual photoperiodic treatment afforded to other *indica* varieties. Both are late winter varieties.

Seeds of T.1242 (flowering time, 122 days), were sown in thirteen pots containing five seedlings each. Treatment of 20 days of 8 hours' duration (7 a.m. to 3 p.m.) was given to the plants at weekly intervals from 0 to 11 weeks.

There was a response (20 days) only when 35 days' old seedlings were treated. Where younger seedlings were treated, the response was negative, perhaps because of the restricted supply of sunlight at early stages of growth and development. It appears as though there is a critical age before which, if photoperiod treatment is given, there is no benefit obtained from such treatment. This critical age may differ with different varieties.

The fact that there is no response to photo-period treatment with seedlings of a particular age should not lead one to believe that the type under consideration is photoperiodically insensitive. The treatment should be tried at various ages of the seedlings before any such conclusions can be drawn.

Central Rice Res. Institute,
Cuttack-4 (Orissa),
June 5, 1953.

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COLD AGGLUTININS IN GLYCINE SOJA

MANY iso-agglutinins such as anti-A, anti-H, anti-M and others act more strongly at refrigerator temperatures than at body temperature. This effect is even more striking in the case of cold auto-agglutinins which may act in very high titres in the cold but yet be inactive at body temperature.

Recently, the action of agglutinins derived from certain seeds has been extensively studied particularly in relation to human red blood cells.¹ Some seed agglutinins bear a close resemblance to human iso-agglutinins; for example, the agglutinins of *Phaseolus lunatus* give agglutination reactions which are apparently indistinguishable from those of human anti-A sera.²

In order to determine if the action of seed agglutinins was influenced by temperature, as in the case of certain iso-agglutinins and auto-agglutinins, parallel titrations of certain seed extracts were conducted at laboratory (28-32° C.) and refrigerator temperatures (6-10° C.) against human erythrocytes of groups O, A and B. The seeds tested were (a) *Dolichos biflorus* and *Phaseolus lunatus* known² to be absolutely specific for the human hæmagglutinin A, (b) *Vicia faba* and *Lathyrus sativus* which contain non-specific agglutinins,^{2,4} and (c) *Cyamopsis psoralioides* and *Glycine soja* (soya bean) previously found to be inactive at laboratory temperatures.³

2 per cent. suspensions of fresh unwashed cells were used and extracts were prepared as described by Boyd and Reguera.⁴ Titrations were carried out using the serial two-fold dilutions method. The results are shown in Table I.

The titre of *Dolichos biflorus* was slightly increased in the cold but that of *Phaseolus lunatus* was the same. The A-specificity of these extracts remained unaltered. The titre of the non-specific extracts was not significantly

increased. These four extracts produced more clear-cut agglutination at refrigerator temperatures. *Cyamopsis psoralioides* remained inactive in the cold but *Glycine soja* was found to contain fairly powerful non-specific cold agglutinins.

TABLE I

Titres of various seed extracts against human erythrocytes at laboratory and refrigerator temperatures

| Species | Laboratory temperature (28°-32° C.) | | | Refrigerator temperature (6°-10° C.) | | |
|-------------------------------|-------------------------------------|----|------|--------------------------------------|-----|------|
| | Cells | O | A B | O | A | B |
| <i>Dolichos biflorus</i> | | 0 | 64* | 0 | 0 | 256 |
| <i>Phaseolus lunatus</i> | | 0 | 2048 | 0 | 0 | 2048 |
| <i>Vicia faba</i> | | 16 | 16 | 16 | 32 | 32 |
| <i>Lathyrus sativus</i> | | 32 | 32 | 32 | 64 | 64 |
| <i>Cyamopsis psoralioides</i> | | 0 | 0 | 0 | 0 | 0 |
| <i>Glycine soja</i> | | 0 | 0 | 0 | 128 | 128 |

* Low titre due to use of seeds about two years old.

Hæmagglutinins in soya bean extracts active against rabbit and rat cells, but not those of sheep and calves, have been mentioned by Liener and Pallansh.⁵ These workers noted their agglutination tests after incubation at 37° C. for 4 hours followed by storage at 4° C. for 12-18 hours. The soya bean extracts used by the present author strongly agglutinated rabbit cells at laboratory temperatures.

Seed extracts known to be inactive at laboratory temperatures might usefully be re-examined at refrigerator temperatures. This may result in the discovery of phyto-agglutinins absolutely specific for the human red cell antigen B or provide additional material for research on erythrocyte antigens.

Blood Transfusion Dept., G. W. G. BIRD.
Armed Forces Medical College,
Poona, June 13, 1953.

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FORMATION OF ISOPOLYMOLYB- DATES AND MOLYBDO-COMPLEXES

STANDARD solutions of sodium molybdate (14.68 g. of $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ /litre) oxalic acid (19.95 g./litre), tartaric acid (36.8 g./litre) and lactic acid (exactly 1N) were prepared. A

sample of G. R. quality was used for preparing sodium molybdate solution and other solutions were standardised. In three sets of experiments, a definite volume of Na_2MoO_4 solution taken in a conical flask and diluted to the same extent (200 c.c.) was titrated conductometrically against oxalic, tartaric and lactic acids added from a micro-burette using a dip-type conductivity cell. The conductance was plotted against the volume of the titrant and breaks were obtained corresponding to the addition of about 4, 7 and 9 H ions for every $6\text{MoO}_4 = \text{ion}$ in the case of all the three acids and the curve was exactly like that reported earlier.² Glass electrode titrations were also carried out using a Marconi p_H meter. The p_H varied from 7.8 to 2.7 and the p_H values corresponding to the conductometric breaks were 6.5, 4.5 and 3.1. All these observations are in accordance with the previous work¹ on isopoly acids where either HNO_3 or HCl was used as the titrant.

Oxalic, tartaric and lactic acids, in addition to supplying the complex forming ligands (groups) supply H ions also. This decreases the p_H of the solution favouring the aggregation process. It is, therefore, necessary to investigate the complex formation under conditions not favourable for any aggregation process.

Our thanks are due to Prof. S. S. Guhasircar for his kind encouragement.

Dept. of Chemistry, D. V. RAMANA RAO.
Ravenshaw College, S. PANI.
Cuttack, July 6, 1953.

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SOLUBILITY PRODUCT OF BARIUM MOLYBDATE

It appears from the *Landolt and Börnstein Tabellen*, that the solubility product of barium molybdate has not been determined. Smith and Bradbury,¹ in 1891, concluded that 1 part of the salt is soluble in 17,200 parts of water at 23° C. The solubility product of barium molybdate is determined accurately in the present work.

Hot aqueous solutions of BaCl_2 and Na_2MoO_4 (G. R. quality), were mixed. The precipitated barium molybdate was filtered out, washed, dissolved in HCl and reprecipitated by NH_4OH . After final washing, it was thoroughly dried at 110° C. The barium and molybdenum contents were estimated gravimetrically by the sulphate and oxine methods respectively to ascertain its

purity. The experimental results in duplicate agreed well with the formula BaMoO_4 .

The solubility product was found to be 3.41×10^{-8} .

Thanks are due to Dr. S. Pani for his help in the work.

Dept. of Chemistry, D. V. RAMANA RAO.
Ravenshaw College,
Cuttack, July 6, 1953.

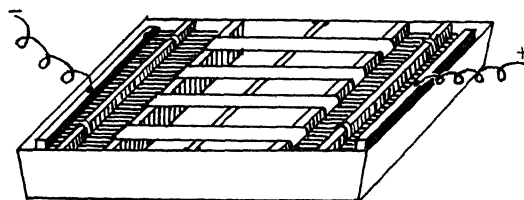
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A SIMPLE APPARATUS FOR PAPER ELECTROPHORESIS

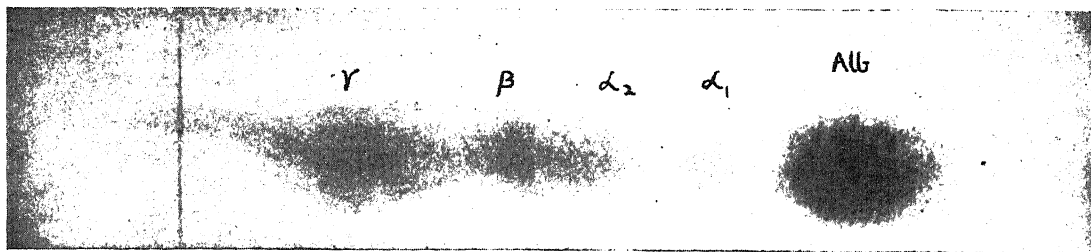
THE technique of micro-electrophoresis on filter-paper is now widely used and many different types of apparatus have been described.¹⁻⁷ A simple and inexpensive apparatus which has given us satisfactory results for nearly a year is described here.

The apparatus (Fig. 1) consists of a glass

Fig. 1



refrigerator drip tray 36 cm. \times 20 cm. \times 6 cm. divided into five compartments by four glass partition walls. The middle compartment is kept 17-18 cm. wide and the other four compartments about 4-5 cm. wide. The compartments are made water-tight by pressing in plasticine moulding compound. The height of the partition walls are kept 0.5-1 cm. less than the height of the tray. Carbon electrodes 18 cm. \times 5 cm. \times 1 cm. are placed in the two end compartments. Buffer of the required pH is then filled into all the compartments except the middle one upto a height of 0.5 cm. below the top level of the partitions. The level of buffer in all the four compartments is made the same with the help of syphons. A pair of wicks is placed over the partition walls of the electrode and adjacent compartment as recommended by Flynn and Mayo.⁵ The wicks help to keep the electrical contact between the two buffer compartments, but prevent the pH changes in the electrode compartment from affecting the adjacent compartment. A glass rod is fixed with the help of plasticine at the top edge of the



central compartment, its position depending on the direction of migration of the proteins in the particular buffer used. Four or five filter-paper strips 4 cm. wide and about 28 cm. long are taken, and on each of these a spot is marked with an ordinary lead pencil to indicate the position for applying the protein solution. The paper strips are then moistened with buffer, and excess moisture is removed by blotting. The moist papers are then placed over the central compartment so that the marked spot will rest on the glass rod and the two ends dip into the buffer compartments. A volume of serum equal to 0.005 or 0.01 ml. is put on the marked spot. The syphons are removed and the tray is covered with a glass plate. Direct current of about 0.6 mA per cm. width of paper strip at 60-120 V is passed. Electrophoresis is usually run for a period of 18-20 hours preferably over-night.

After electrophoresis, the paper strips are dried and stained for 10 minutes with 1 per cent. bromphenol blue in ethanol saturated with mercuric chloride. The excess dye is washed out with 0.5 per cent. acetic acid.⁴ For quantitative work, the dyed papers are cut into strips, the colour eluted and measured colorimetrically according to the method of Kunkel and Tiselius,⁴ or nitrogen is estimated directly in the cut strips by micro-Kjeldahl procedure according to the method of Levin and Oberholzer.^{8,9}

The apparatus is suitable for carrying out two-dimensional electrophoresis by using a single sheet of paper instead of strips. Paper partition chromatography can also be carried out in the second dimension, if necessary.

A thick uniform paper like Munktell 20 is particularly suited for paper electrophoresis. Whatman No. 31 is the next best. The more readily available Whatman No. 3 is suitable for blood proteins. Whatman No. 1 paper often gives rise to trailing with some proteins, though not much with blood proteins. Fig. 2 shows separation of serum proteins on Whatman No. 3 paper.

Dept. of Antitoxins and Sera,
Haffkine Institute,
Bombay-12, July 9, 1953.

S. S. RAO.

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CAFFEINE CONTENT OF COFFEE

THE estimation of caffeine is one of the important methods for deciding the purity of a sample of coffee, and it is also one of the chief methods of estimating the percentage of adulteration in cases where specific adulterants have been detected by microscopic examination. The method adopted for the caffeine estimation in this Laboratory is based on that of Fendler and Stüber.

In the course of analytical work carried out here over a period of more than two decades, the highest figure obtained for the caffeine content of genuine coffee samples varied between 1.2 and 1.7 per cent. This figure has been supported very well by the observations of Lythgoe and Leach.

Recently, however, ever since coffee became scarce and costly, interesting cases of coffee samples with abnormally high caffeine contents of 2.2 to 2.6 per cent. have been met with during the regular analysis of coffee samples in our laboratory. Such high values of caffeine are characteristic of some varieties of coffee of African origin only. The sudden increase in this important analytical figure has, therefore, to be presumed to be due to the arrival in the market of new varieties of coffee. These varieties may presumably be the African varieties cultivated in India, or cultivated varieties

obtained by crossing the Indian and African varieties.

In every case, the genuineness of the coffee was established beyond doubt by a thorough microscopic examination.

The purity of the caffeine in all the above cases was confirmed by the estimation of nitrogen on the caffeine by the Kjeldahl method. The purity was in no case less than 96 per cent. caffeine.

Public Analyst's Lab., V. VENKATACHALAM.
Ripon Buildings, S. SUNDARAM.
Madras-3, July 23, 1953.

MALFORMATIONS IN SUGARCANE

WHILE in paddy and ragi (*Eleusine coracana* Gaertn.) Anandan and Krishnaswami¹ and Diwakaran, *et al.*,² respectively by experimental work in field, and Sampath and Krishnaswami³ by cytological evidence in the case of the former, showed that the formation of a leafy shoot in place of an inflorescence was a recessive Mendelian character, Lyon⁴ who also noted a similar phenomenon in sugarcane offered no explanation. In view of the vegetative propagation in cane, it might straightaway be stated that it could not have been genetical in nature, as was the case in the two plants mentioned above.

In the course of his work on cane-breeding, the author found that of the six varieties, namely, Co 313, Co 331, Co 419, Co 508, B.O. 11* and P.O.J. 2961, only Co 313 which alone flowered at Pusa developed "bunch tops" (expression used by Lyon) in 13 stalks in February 1951, 14 in March and 17 in April, thus totalling 44 out of 227 stalks observed (Fig. 1). In the case of the other five varieties 51-64

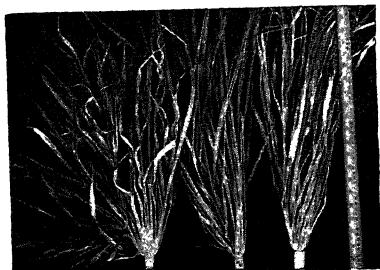


FIG. 1

stalks of each were closely watched. B.O. 11, however, was found to develop leafy shoots in three stalks towards the end of April 1951 at

Hassanpur (District Darbhanga; nearly 50 miles to the east of Pusa) where five of its stalks were in short-blade stage. Next season again, out of 288 stalks of Co 313, leafy shoot was formed in 13, 11 and 13 stalks respectively in March, April and May 1952.

On the basis of these observations the following tentative hypothesis might be put forward to explain the phenomenon.

Sugarcane being photo-periodically a short-day plant, its stalks are inducted into reproductive phase in winter when the terminal growing point breaks up into so many small growth primordia to develop into rachillae of the panicle which, however, are not formed, if the fragmentation of the apical meristem takes place late in season, because with the increase in the day-length, the reproductive metabolic activities are inhibited and with the advent of still longer days, the stalk is pushed back into the realm of vegetative growth. But long-day cannot undo the modifications already effected by short-day period. As such, the daughter-primordia develop into as many leaves with the result that instead of an inflorescence, a leafy shoot is formed at the apex.

Thus the formation of a leafy shoot or of an inflorescence by the terminal growing point appears to be the end-product of a series of interactions between the environmental and physiological processes going on within a cane. The presence of a leafy shoot and an inflorescence in more or less the same plane in a very rare case (Fig. 2) appears to indicate that so far as this chain of reactions is concerned, a stalk as a whole does not behave as one entity. It seems daughter-primordia or groups of them



FIG. 2

at least are independent of each other in this respect.

Funke⁵ and Struckmeyer⁶ have experimentally effected reversion from reproductive to vegetative phase respectively in *Perilla ocymoides* and *Salvia splendens* var. *Harbinger*, while such reversion is quite a normal feature of the growth-cycle of pine-apple stem.

Grateful thanks of the author are due to Sri. K. L. Khanna, Director of this Station, for so kindly providing facilities for this work and for his keen interest in its progress.

Central Sugarcane Research Station,
Pusa, Bihar, August 30, 1952.
S. L. SHARMA.

* B.O. is a series of sugarcane varieties bred and selected at Central Sugarcane Research Station, Pusa (Bihar).

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ARGINASE AND URIC ACID IN *ACHATINA FULICA* (FER.)

BALDWIN¹ confirmed Clementi's findings of arginase in the hepatopancreas and also found this enzyme in the nephridium of *Helix pomatia*. Recently, Lal and Saxena² reported the presence of arginase in the hepatopancreas of the common Indian apple-snail, *Pila globosa* (Swainson). The present communication deals with a study of arginase and uric acid in another form *Achatina fulica* (Fer.), introduced into India by Benson in 1847. This snail is completely terrestrial in habit and offers a good comparison with *Pila globosa* which is practically an amphibious form. The details of the experimental procedure are given below:—

For the determination of arginase the hepatopancreatic gland was dissected out of the live snail and immediately weighed. A 'brei' of the fresh tissue was prepared according to the technique of Baldwin,¹ brought to pH 9.5 and incubated with a 5 per cent. solution of L-arginine-monohydrochloride at 28° C. for 60 minutes using glycine solution as buffer. A few drops of toluene were added as an antiseptic. The urea formed was decomposed into ammonia by urease at pH 5 in the presence of acetate buffer. Ammonia was thereby estimated titrimetrically. The yield of urea-CO₂ c.cm. was duly corrected

for the tissue and solution blanks. The result is expressed here in the QH notation of Krebs and Henseleit as done by Baldwin² and is Q²⁶_H 315.

For the estimation of uric acid the nephridium of the snail was weighed in tared crystal glasses, dried in hot air-oven at 110° C. for approximately two hours till its weight became constant, and the water content of the tissue was thereby calculated. The dry tissue was powdered and uric acid therein extracted repeatedly over a water-bath at 80° C. in distilled water. The extracts thus obtained were made upto the desired volume with distilled water. The uric acid in the aliquot samples of the extracts was estimated by Benedict's Colorimetric method as described by Cole³ using a Klett-Bio-Colorimeter. The yield of the uric acid was 265 mg. per gram dry weight of the tissue. Control and blank tests were performed simultaneously. All experiments were carried out at room temperature.

Lal and Saxena² did not report any appreciable quantitative difference in the occurrence of arginase in the hibernating *P. globosa* and those living in an aquarium. The accurate figures of these estimations will be published elsewhere. On the contrary no arginase was detected in those specimens of *A. fulica* which had hibernated for about six months in the laboratory.

Baldwin¹ correlated the increasing amounts of arginase found in terrestrial forms over marine and fresh-water forms to a possible uricogenesis. The yield of both arginase and uric acid is more in *A. fulica* which is a completely terrestrial form than in *P. globosa* which is an amphibious snail. This rise in the arginase content in the hepatopancreas of *A. fulica* may also be related with the elaboration of uric acid as a nitrogenous waste to some extent.

My thanks are due to Dr. M. B. Lal under whose guidance this work was completed, to Mr. B. K. Tandan for kindly obtaining the specimens of these snails for me from Madhupur, Bihar, and to Dr. S. L. Hora of the Zoological Survey of India for the identification of these snails.

Dept. of Zoology,
The University, Lucknow,
May 1, 1953.

B. B. SAXENA.

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**CHROMOSOMES OF *OPATROIDES*
VICINUS FAIRM. (COLEOPTERA:
TENEBRIONIDÆ)**

LITTLE attention seems to have been paid to the cytology of Coleoptera in this country, although quite a number of species have been studied in other countries by Stevens,¹ Nonidez,² Smith,³⁻⁵ Guenin^{6,7,8} and Yoshida.^{9,10} Our knowledge regarding the chromosomes of Indian Coleoptera is primarily due to Asana, Makino and Niiyama¹¹ and Bose.¹² The present paper reports on the chromosome number and the meiosis in a species of tenebrionid beetle, *Opatroides vicinus* Fairm., collected during the month of May 1950, at Izatnagar in the Uttar Pradesh.

Testes from adult males were dissected out in a living condition and fixed in medium flemming. Sections were cut 12 micra thick and stained in iodine crystal violet after overnight premordanting in 1 per cent. chromic acid.

The spermatogonial metaphase plate shows the chromosome number to be $2n=20$. The largest acrocentric chromosome of the complement is the X, while the smallest dot-shaped one represents the Y chromosome (Fig. 1). This

number appears to be very characteristic in three families of Coleoptera and has been recognised by Smith⁴ as the primitive cytological constitution in the order Coleoptera as a whole. A study of the chromosome complement in the present species shows fifteen acrocentric chromosomes, four metacentric ones and the Y, which is almost near the limit of visibility. The latter looks very much understained at metaphase. At spermatogonial resting stage, the X chromosome remains positively heteropycnotic and lies very close to the nuclear membrane (Fig. 2). The zygotene stage shows polarisation of all the chromosomes towards the heteropycnotic X chromosome which again is found very near the nuclear membrane (Fig. 3). At diplotene there are seven autosomal bivalents, which are rod-shaped, two ring-shaped ones and the sex bivalent (Fig. 4). The chiasmata in all the bivalents are found to be terminal at this stage. At first meiotic metaphase, the XY bivalent remains slightly understained and at first it is off the plate with the Y chromosome always oriented towards the equatorial plate (Fig. 5). Later on the sex bivalent occupies a position along with the other bivalents and, therefore, polar views of metaphase I always reveal ten elements (Fig. 6). The first division anaphase is reductional for the sex chromosome (Fig. 7) and consequently two types of second division plates are seen—one with the X chromosome and the other with the Y (Figs. 8 and 9).

The work was carried out at the Division of Animal Genetics, Indian Veterinary Research Institute, Izatnagar. The author wishes to express his indebtedness to Dr. P. Bhattacharya, for offering necessary facilities, and to Dr. A. P. Kapur, ILRI, Ranchi, for the identification of the material.

Dept. of Zoology,
University of Delhi, Delhi-8,
June 22, 1953.

M. K. DUTT.

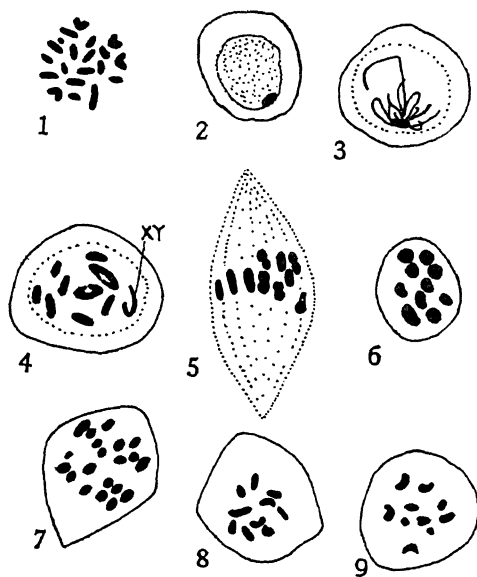


FIG. 1. Spermatogonial metaphase plate. FIG. 2. Spermatogonial resting stage. FIG. 3. Zygotene stage. FIG. 4. Diplotene stage. FIG. 5. First meiotic metaphase. FIG. 6. Metaphase I polar view. FIG. 7. Anaphase I stage. FIG. 8. Metaphase II with the X chromosome. FIG. 9. Metaphase II with the Y chromosome. Diagrams are reproduced at a magnification of 2114.

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**OBSERVATIONS ON THE BIOLOGY OF
SCELIO HIEROGLYPHI TIMBERLAKE
(SCELIONIDAE, HYMENOPTERA)**

AYYAR¹ found *Scelio hieroglyphi* Gir. parasitising the eggs of the rice grasshopper, *Hieroglyphus banian* Fabr. at Coimbatore. Excepting this record, no observations on the incidence and biology of this important parasite appear to have been made.

Collections of egg-pods of the rice grasshopper made from the paddy fields round about Bangalore during June 1952, and incubated in moist soil in the laboratory, showed that up to 15 per cent. of the egg-pods were parasitised by the scelionid. Parasites alone (and in some cases, both parasites and hoppers) emerged from individual egg-pods. Most of the parasites emerge in the fields just after the onset of the south-west monsoon rains, i.e., June-July, when most of the hoppers from unparasitised eggs also emerge.

In the laboratory, *S. hieroglyphi* was found to attack, and successfully complete its development in the eggs of the grasshoppers, *Attractomorpha crenulata* Fabr., *Oedaleus nigrofasciatus* Sauss., *Oxya multidentata* Will., and *Phlocba* sp. However, *O. multidentata* was considered to be the most suitable laboratory host in view of its availability in nature, and easy rearing in the laboratory, throughout the year, and its fairly short egg-period.

Detailed observations on the oviposition-behaviour of the parasite were made by enclosing parasites along with pairs of adult grasshoppers (*O. multidentata*) in small jars in which moist soil for oviposition and grass as food of the grasshoppers were provided. One or more of the female parasites in the jar are usually attracted to the ovipositing grasshopper, and they wait for the grasshoppers to complete the act of oviposition and then immediately attack the host egg-pod, which may be laid inside the soil ($\frac{1}{2}$ " to 1" below the surface), or between clumps of grass. The ovipositor may continue to be inside the host egg-pod for over 1-1½ hours, all the time exhibiting alternate movement and apparent inactivity, after which the parasite slowly draws itself away from the host egg-pod. The parasite, though usually preferring freshly laid eggs, has been sometimes seen to attack one or even two-days-old eggs, when enclosed along with them, and to successfully complete its development.

All the early stages (egg, larva and pupa) of the parasite are passed within the host-egg, only one parasite completing its development in each

egg. Almost the entire contents of the parasitised egg may be consumed by the time the parasite pupates within the host-egg. The time required for one generation, from egg-laying to emergence of the adult, ranges from 29 to 35 days, which compares well with the incubation period of the grasshopper. The duration of the emergence of the parasites from a parasitised egg-pod may extend up to a week. Both male and female parasites and hoppers from unparasitised host-eggs emerge almost at the same time from individual egg-pods.

The adults are active immediately after emergence and move about briskly on the sides of the breeding jar, on the soil at the bottom and even actively get into cracks and crevices in the soil. When disturbed, they drop down exhibiting the death-feigning habit for one or two seconds, and then resume their activity. The adults live for a period of 8-12 days without apparently taking any food except water, that may settle on the glass jar. The size of the adult varies directly with the size of the host-egg, the one reared from the eggs of *Oxya* being the smallest and that from the rice grasshopper the largest and the rest intermediate in size.

Further detailed observations are in progress and the results will be published in due course.

The author is indebted to Sri B. Krishnamurti for encouragement. He is also thankful to Dr. C. F. W. Muesebeck, U.S.D.A., for the identification of the parasite; and to the Director, Commonwealth Institute of Entomology, London, for the determination of the grasshoppers mentioned in the note.

Div. of Entomology, G. P. CHANNA BASAVANNA.
Dept. of Agriculture,
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**VERNALISATION RESPONSE IN *LENS
ESCULENTA* MOENCH**

WITH a view to find out whether *Lens esculenta* responds to low temperature treatment and to determine the optimum time of chilling to produce maximum earliness, work was undertaken by the author in 1948. The results are presented in this paper.

Vernalisation response was studied by soaking the seeds of variety 4315-I for 24 hours in water and then chilling them at 6-9° C. for 8, 16, 24 and 32 days in a refrigerator. Proper care was taken to see that germination of seeds

did not stop due to lack of moisture. The sprouted seeds were sown along with a control in replicated progeny rows. There were 5 plants in each row and 4 replications. Data regarding the duration of vegetative phase for different treatments is given in Table I and Table II gives the analysis of variance.

TABLE I
Duration of the vegetative phase

| Period of chilling | Duration of vegetative phase Replications | | | | Mean |
|--------------------|-------------------------------------------|------|------|------|-------|
| | 1 | 2 | 3 | 4 | |
| Days | Days | Days | Days | Days | Days |
| 32 | 42.6 | 42.2 | 42.4 | 42.6 | 42.45 |
| 24 | 51.0 | 50.8 | 52.0 | 51.0 | 51.20 |
| 16 | 53.8 | 54.4 | 53.4 | 54.2 | 53.95 |
| 8 | 56.6 | 56.4 | 57.0 | 57.4 | 56.85 |
| Control | 62.4 | 62.0 | 64.4 | 63.4 | 63.05 |

TABLE II
Analysis of variance

| Variance due to | Degrees of freedom | Sum of squares | Mean sum of squares | F. value | |
|-----------------|--------------------|----------------|---------------------|-------------|-------|
| | | | | Experi-ment | Table |
| Blocks | 3 | 1.64 | .546 | .02 | .. |
| Treatments | 4 | 702.58 | 175.645 | 9.5 | 3.11 |
| Error | 12 | 221.5 | 18.458 | .. | .. |
| Total | 19 | 925.72 | | | |

It is seen from the value of critical difference which is 6.60237 at 5 per cent. level of significance that there is no significant difference between 8, 16 and 24 days' treatments but 32 days' treatment shortens the vegetative cycle significantly both over control and rest of the treatments. This shortening of the vegetative cycle in 32 days' treatment was by nearly 21 days. Pal and Murty¹ produced earliness in different varieties of gram, namely, IP₁₇, IP₇₀, IP₄₈ and IP₉ of 10.22, 12.05, 12.5 and 13.22 days respectively. They also produced an earliness of 1.17 days in soyabean.

Thus the optimum time of chilling for *Lens esculenta* seeds is 32 days at 6-9° C. to produce an earliness of about three weeks.

My thanks are due to Dr. Bahadur Singh, Dr. N. K. Anantrao and Dr. S. C. Chakravarti for valuable guidance.

Dept. of Biology,
A. S. Jat College, Lakhaoti,
Bulandshahr, April 1953.

T. C. SHUKLA.

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SOME NEW HOSTS OF CEPHALEUROS FROM BIHAR

In this paper, an attempt has been made to record a number of hosts of the alga, *Cephaleuros*, collected from different parts of Bihar.

In order to know the epiphytic or parasitic nature of the alga, hand sections were cut, stained and studied. In *Mimusops hexandra* Roxb. collected from Patna, it was found that the alga is parasitic, as a major portion of it is intramatrical. In the case of *Psidium guava* L. collected from Patna, the alga is parasitic as reported.¹

But in the case of the hosts mentioned below, the alga is epiphytic.

PATNA.—*Dalbergia sissoo* Roxb., *Alstonia scholaris* Brown., *Mangifera indica* L., *Albizia lebbek* Benth., *Barringtonia acutangula*, Gaertn., *Achras sapota* L., *Eugenia jamboliana* Lamk., *Magnolia glauca* L., *Cordia myxa* L., *Putranjiva roxburghi* Wall., *Nephelium litchi* Camb., *Butea frondosa* Roxb., *Magnolia grandiflora* L., *Citrus medica* L. RAJGIR.—*Carissa carandus* L. RANCHI.—*Murraya exotica* L., *Thea sinensis*. PARASNATH HILLS.—*Loranthus longiflorus* Desr., *Cleodendron infortunatum* Gaertn.

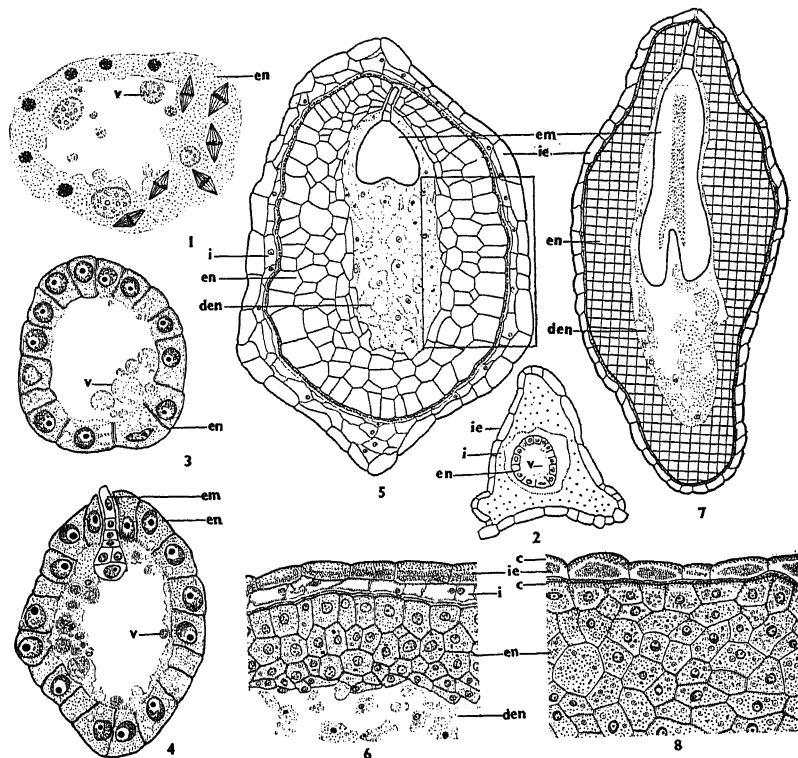
Dept. of Botany, Science College, A. S. YADAV.
Patna, May 6, 1953.

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THE ENDOSPERM AND SEED STRUCTURE OF OLDENLANDIA CORYMBOSA LINN.

RAGHAVAN AND RANGASWAMY¹ noted that in *Oldenlandia alata* the endosperm is nuclear and wall-formation takes place when the proembryo has reached the quadrant stage. The developing endosperm encroaches upon the integumentary cells and only a thin layer of the latter persists in the mature seed. Since the endosperm of *O. corymbosa* shows some interesting features which have not been reported earlier in the family Rubiaceae, a brief account is given here.

The primary endosperm nucleus undergoes several synchronous free nuclear divisions and the daughter nuclei take up a peripheral position delimiting a large central vacuole (Fig 1). During these changes the zygote remains inactive. It divides after about 32 endosperm nuclei have been formed. Wall-formation is initiated when the proembryo has reached the four-celled stage.



FIGS. 1-8. *Oldenlandia corymbosa* Linn. (c, cellulose thickening; den, degenerating endosperm; em, embryo; en, endosperm; i, integument; ie, integumental epidermis; v, cytoplasmic vesicle). Fig. 1. T.S. of embryo sac showing endosperm and cytoplasmic vesicles (before wall-formation), $\times 62$. Fig. 2. T.S. of young seed $\times 17$. Fig. 3. Detailed structure of endosperm and cytoplasmic vesicles shown in Fig. 2, $\times 62$. Fig. 4. L.S. of endosperm and embryo, $\times 62$. Fig. 5. L.S. of young seed showing central degenerating endosperm different from the peripheral endosperm, $\times 28$. Fig. 6. Detailed structure of a portion of endosperm and integument shown in Fig. 5, $\times 37$. Fig. 7. L.S. of almost mature seed, $\times 28$. Fig. 8. Detailed structure of testa and endosperm of a mature seed $\times 37$.

Prior to wall-formation certain cytoplasmic vesicles begin to protrude into the central vacuole. Gradually they become rounded and are finally cut off from the general cytoplasm containing the endosperm nuclei. The vesicles do not possess any nuclei but vary in size and are irregularly distributed (Figs. 1-4). With the centripetal extension of the endosperm cells the vesicles diminish in size and number and finally disappear. Such cytoplasmic vesicles in the endosperm have not been reported previously in any plant of the Rubiaceae.

Recently the presence of non-nucleated cytoplasmic vesicles has been reported in *Pennisetum typhoideum* Rich. (Narayanaswami²). Endosperm vesicles have also been reported in *Musa*,³ *Musa errans*⁴ and *Isomeris arborea*⁵ but in these cases the vesicles are nucleated. In *Isomeris* the vesicles are said to give rise to embryos. No such case has, however, been noted in *Oldenlandia corymbosa*,

Periclinal divisions take place in the outer layers of the endosperm which now fills the embryo-sac and at the same time encroaches upon the adjacent integumentary cells which are gradually consumed until only the epidermis is left. The cells of the latter contain tannin and at maturity the outer tangential walls become thickened due to the deposition of hemi-cellulose (Figs. 6, 8).

The endosperm cells contain large starch grains and some crystalline material which stains black with iron-haematoxylin (Figs 6, 8). These cells, which are adjacent to the heart-shaped proembryo, appear famished and lie in a loose mass (Figs. 5, 6 and 7). As the embryo grows, they are gradually consumed until only 3-5 layers of the endosperm cells are left (Fig. 6). In *Phyllis*⁶ also, another member of the Rubiaceae, the endosperm cells lying in close proximity of the proembryo degenerate and lose their contents but the "lattice-work" of

their walls remains intact. The cells of the peripheral endosperm layer become highly thick-walled due to the deposition of hemi-cellulose which gradually extends to the inner cells (Fig. 8).

The mature seed of *Oldenlandia corymbosa* consists of a typical dicotyledonous embryo and 3-5 layers of endosperm cells, enclosed in a single-layered testa (Fig. 7). A one-layered testa has also been reported in other members of the family Rubiaceae, viz., *Callipeltis cucullaria* and *Sherardia arvensis*⁷ and *Borreria hispida*.⁸ On the other hand, in *Oldenlandia alata*, *Dentella repens*¹ and *Vaillantia hispida*⁷ the testa is two-layered.

I am grateful to Prof. P. Maheshwari and Dr. B. M. Johri for suggesting this problem and for their helpful guidance.

Dept. of Botany,
Aligarh Muslim University,
Aligarh, July 1, 1953.

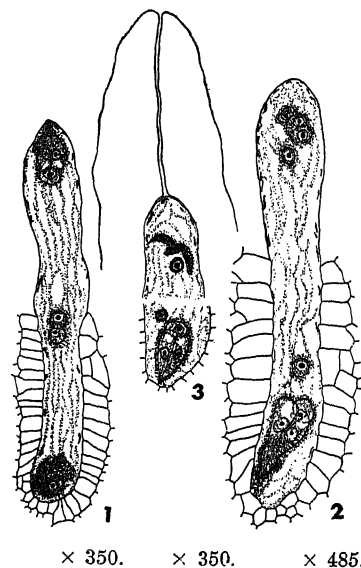
M. FAROOQ.

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INVERTED POLARITY IN THE EMBRYO-SAC OF SAURAUJA NAPAULENSIS DC.

In the development of the Polygonum type of embryo-sac, the division of the primary micropylar and antipodal nuclei is a well studied phenomenon. The micropylar quadret, in the mature embryo-sac exhibits more or less a specific pattern, whereas the chalazal quadret is subject to many kinds of variations. Sometimes the primary chalazal nucleus may divide a number of times or there may be reductions in the usual number of divisions (Maheshwari, 1948). The antipodals may divide or persist, either before, or after, or till, the stage of fertilisation. Cases are also known where there is a marked similarity between the micropylar and chalazal quadrets. Some extreme cases are also on record (Swamy, 1946), where the antipodals which appear like the normal egg apparatus persist until the time of fertilisation, and the micropylar unit shows similarity to normal antipodals. Such cases of inverted polarity have been observed in several families of angiosperms though they are not of frequent occurrence.

During the course of an embryological investigation in Ternstroemiaceae, the writer has observed a case of inverted polarity in *Saurauja napaulensis*. In this form, the development of the embryo-sac is according to the polygonum type. The normal embryo-sac is long with an egg apparatus that includes the two-hooked synergids and an egg; the two polars that usually meet in the centre, and lastly the three antipodal cells which are situated in the chalazal end (Fig. 1). In a few cases, however, the phenomenon of "inverted polarity" has been observed. In the micropylar region, there are



three antipodal cells, and the micropylar polar is about to migrate. The three nuclei of the antipodal pole, on the contrary, are organised into typical cells and show a remarkable similarity to the normal egg apparatus. The synergids show the basally situated vacuoles and their hooks are just developing (Fig. 2). In still another case, the nuclei at the micropylar end show signs of degeneration, whereas the chalazal quadret appears like a normal egg apparatus (Fig. 3).

My sincere thanks are due to Prof. L. N. Rao and Dr. S. B. Kausik for suggestions; and the University of Mysore for the award of a Research Fellowship.

Dept. of Botany,
Central College,
Bangalore, July 29, 1953.

A. NAGARAJA RAO.

1. Maheshwari, P., *Bot. Rev.*, 1948, **14**, 1-56. 2. Swamy, B. G. L., *Ann. Bot.*, 1946, **9**, 171-83.

REVIEWS

The Stability of Rotating Liquid Masses. By R. A. Lyttleton. (Cambridge University Press), 1953. Pp. 147. Price 35 sh. net.

The aim of the book is to give in clear and concise manner the chief contributions to the classical problem of mathematical astronomy, viz., the stability and evolution of rotating gravitating liquids. Chapter I gives a historical development of the subject, and discusses the contributions of the greatest mathematicians like Newton, Clairaut, Maclaurin, Jacobi, Poincaré, Tchebychef, Liapounoff and Jeans to this problem. Chapter II is devoted to the study of the stability of statical and dynamical systems. Criteria are developed for systems rotating with constant angular velocity. Ordinary and secular stabilities are described in some detail and the conclusion is reached that in some problems of cosmogony ordinary stability may be equally or perhaps more important than secular stability.

Chapter III deals with the stability of a spherical form, which evidently corresponds to the case of uniform density and no angular momentum. In Chapter IV, spheroidal and ellipsoidal forms are found as possible forms of equilibrium, when the density is uniform. The stability of Maclaurin spheroids and Jacobi ellipsoids is also discussed for certain ellipsoidal deformations. Chapters V and VI are concerned with finding solutions of Laplace's equation in terms of ellipsoidal harmonics. Lamé functions are introduced and some properties of these functions are developed with special reference to gravitation. In Chapters VII and VIII, the secular stability of the Maclaurin spheroids and Jacobi ellipsoids is discussed. When certain restricted second order displacements are only allowed the Maclaurin series gives rise to the Jacobi series. There exists another point of bifurcation on the ellipsoidal series which gives rise to pear-shaped figures. This series is secularly unstable initially. If entirely undisturbed, it would continue in rigid-body rotation. Even for a slight disturbance the system would gradually depart from the pear-shaped form and settle down to the Jacobi form possessing the same angular momentum. This, however, being unstable the further evolution of the system will depend on its ordinary stability. In Chapter IX general equations of small motion of a rotating non-

viscous liquid are set up. Neglecting the quadratic terms of inertia in the equations of motion it is shown that ordinary stability ceases with secular stability, with the result that the series becomes unstable after the bifurcation of pear-shaped forms. In the concluding chapter the cosmological implications of the conclusion reached in earlier chapter are discussed, and it is shown that dynamical evidence is wholly against the fission hypothesis of Jeans.

This book should prove of great interest to astrophysicists, astronomers and mathematicians.

B. R. SETH.

Data for X-Ray Analysis, Vol. I. Charts for Solution of Bragg's Equation. By W. Parrish and B. W. Irwin. Pp. 81. Vol. II. **Tables for Computing the Lattice Constant of Cubic Crystals.** By W. Parrish, M. G. Ekstein and B. W. Irwin. (Philips Technical Library), 1953. Distributors: Philips Electrical Co. (India), Ltd., Calcutta 20. Pp. 99. Price Rs. 10 each.

The volumes under review are the first two of a series of publications proposed to be brought out by the Philips Technical Library, with the idea of supplementing the tables available in the International Tables for X-ray crystallography. The first volume contains a set of 85 charts for rapidly obtaining the lattice spacing d from the Bragg angle θ for various radiations (the K lines of Mo, Cu, Co, Fe and Cr). Each chart covers a range of 2.5° for θ , and the charts give the d -spacing correct to 0.01 \AA in the range 3° to 18° and to 0.001 \AA at higher angles. The charts are easy to read and are found to be very convenient to use. They are particularly useful in interpreting powder diffraction lines.

The second volume contains tables which enable one to calculate the lattice constant a of a cubic crystal from the measured glancing angle θ . In the well-known relation between the two, viz., $a = \sqrt{N}(\lambda/2)/\sin\theta$, ($N = h^2 + k^2 + l^2$), the quantity $\sqrt{N}\lambda/2$ is tabulated for several wavelengths for the various reflections hkl upto $N = 378$ for Cu and similarly for the other wavelengths. In order to extrapolate the values obtained from these to $\theta = 90^\circ$, tables of $\sin^2\theta$ and of $\frac{1}{2}\left(\frac{\cos^2\theta}{\sin^2\theta} + \frac{\cos^2\theta}{\theta}\right)$, the two commonly used functions, are tabulated. The volume also

contains a table of lattice constants of cubic substances and schematic diagrams showing the diffraction patterns of representative cubic substances.

It was a happy idea of the Philips Laboratories to have brought out these tables in such a handy form. The graphs and tables are printed neatly with easy-to-read large types and the reviewer feels that they will be widely appreciated by all X-ray workers. The appearance of further volumes in the series will be eagerly awaited.

G. N. RAMACHANDRAN.

Die Gas Turbine. By J. Kruschik. (Wien-Springer), 1952. Pp. xi + 469. Price \$ 15.00.

The book can be regarded as a well arranged compilation of the general knowledge and published data in the field of Gas Turbine Technology. A number of cycles are considered in their thermodynamic aspects, and the data for their theoretical treatment are given. A large proportion of the book is directed to the design of compressor, turbine, heat exchanger and combustion systems, and in this respect, the book gives an excellent account of current practice, especially if the chapter on materials, added later in the volume, is considered along with the design problems. A number of tables and other information will prove helpful to the designer. The behaviour under varying conditions of work of different arrangements of the main components is considered in detail and the influences of regeneration of heat, inter-cooling and reheat are established along with part load characteristics of different cycles. The advantages of closed cycle which render it essential if the utilization of lower grade fuels is intended, are well presented, and a short account is given also of the rather complicated so-called semi-closed cycle. The book ends with a large chapter on the fields of applications of gas turbines for stationary purposes, for road and rail transport, for ships, and lastly for aviation, in its two forms of the pure jet and the prop jet.

It may be said that the book would have been even more useful if its scope had been restricted somewhat. The account on heat exchangers, for example, could have been more thorough, and similar matter should be extended perhaps at the expense of the descriptive parts. Thereby the danger would also be avoided that the book becomes obsolete too quickly due to the fast developments in the field. For later editions it may be advisable to subdivide the book into two volumes which would allow adequate coverage of the subject.

In spite of these remarks the book is very valuable for the advanced scholar and practical engineer, and it is recommended wholeheartedly.

H. A. HAVEMANN

Reactivity of Free Radicals. (*Discussions of the Faraday Society*, No. 14). (The Abdeen University Press Ltd.), 1953. Pp. 2. Price 35 sh.

The volume under review contains a report of the general discussion on the reactivity of free radicals held in Toronto under the auspices of the Faraday Society during 1952.

Since the previous discussions of the Society on 'free radicals' in 1934 and 'the labile molecule' in 1947, the need has been felt for quantitative data on reaction rates, activation energies, bond-dissociation energies, etc., as applied to radicals. The present discussion may be said to have made substantial contribution in that direction.

The absorption spectra of amide radicals in explosions and photochemical reactions between chlorine and oxygen, have been studied by flash photolysis in the gas phase. The technique of mass spectrometry has been employed for the determination of the concentrations of free radicals produced by the thermal decomposition of ethylene oxide, propylene oxide, etc. The reaction of methyl radicals with hydrogen isotopes, of atomic hydrogen and active nitrogen with ethane and other hydrocarbons, and photochemical radical reactions involving ethyl ketone, nitric oxide, etc., are some of the other reactions also discussed.

Referring to the liquid phase, the following have received exhaustive treatment—kinetics of photo-oxidation of various substituted anthracenes in hydrocarbon solvents, addition of bromotrichloromethane to cyclohexene, amyl acetate, oxidation of benzene by ferrous hydrogen peroxide system, reactions between cumene hydroperoxide and polyethylene polyamines, mechanism of catalytic action of transition metals in auto-oxidation reactions, liquid phase olefinic oxidations by hydroperoxide catalysis, etc.

The discussion has provided enough material to put the chemistry of radicals on a sound quantitative footing and will prove a valuable guide and reference work for those who are engaged on research in olefin oxidation, polymerization, photo-chemistry and allied subjects.

M. SANTHAPPA

The Chemistry and Physiology of the Nucleus. (*Experimental Cell Research Supplement 2*), 1952. (Academic Press Inc., New York), 1952. Pp. ix + 402. Price \$ 7.00.

During the past decade increasing attention has been focussed on the chemistry and physiology of the nucleus. Genes are accepted today as chemical entities belonging to the class of nucleoproteins. The chemical and physical structure of nucleoproteins have thus become of absorbing interest in attempts to evaluate the biological individuality of the genes (Stern, K. G., "Problems in Nuclear Chemistry and Biology"). The suspicion that evolutionary advances may be accompanied by increase in the complexity of the DNA seems to have been confirmed by the analytical results on a variety of organisms. The DNA's of some bacterial viruses are composed of "only three kinds of nucleotide, while other viruses and bacteria contain four, and those of some higher animals and plants have five" (p. 213, Wyatt, C. R., "Specificity in the Composition of Nucleic Acids"). It is now considered possible that there may be as many "DNA's as there are genes in the cell" (p. 195, Bendich, A., "Studies on the Metabolism of Nucleic Acids"). The curious fact remains that recent advances have tended to confuse rather than clarify the vital problem of the biological function of nucleic acids.

Contributions to the symposium include: "Nucleoproteins of the Nucleus" (Pollister, A. W.), "Role of Nucleus in Protein Synthesis" (Haurowitz, F. and Crampton, C. F.), "Chemical Action of X-Rays on Nucleic Acids and Related Substances in Aqueous Systems" (Scholes, G. and Weiss, J.), "Enzymes of Isolated Nuclei" (Dounce, A. L.), "Histochemical Demonstration of Nuclear Enzymes" (Novikoff, A. B.), "Evidence for the Polynucleotide Nature of Cysteinylglycinase" (Binkley, F.), "Organization and Function of Inorganic Constituents of Nuclei" (Poulson, D. F. and Bowen, V. T.), "Effect of Purines and Other Chemotherapeutic Agents on Nuclear Structure and Function" (Bieseke, J. J., Berger, R. E., Clark, M. and Weiss, L.), "Chromosome Metabolism as Shown by Autoradiographs" (Pelc, S. R. and Howard, A.), "Origin of Bacteriophage Nitrogen, Carbon and Phosphorus" (Putnam, F. W.), "Fate of the Infecting Virus Particle" (Kozloff, L. M.), "Biological Nature of Bacterial Transforming Factors" (Hotchkiss, R. D.), "Lampbrush Chromosomes" (Gall, J. G.), and "Relationships between Ionizing Radiation, Chromosome Breakage and Certain Other Nuclear Disturb-

ances" (Sparrow, A. H., Moses, M. J. and Dubow, R. J.).

As in any rapidly advancing field, there is a large amount of speculation. Discussions of the papers are stimulating.

There is considerable divergence of opinion as to the structure and behaviour of the bacterial nucleus. The views of the American workers find emphasis in the paper, "Current Status of the Bacterial Nucleus" (Delamater, E. D., Hunter, M. E. and Mudd, S.). Bacterial cytology will remain a controversial field so long as no attempt is made to correlate results obtained on the same organism under a variety of cultural conditions. Inoué's studies ("The Effect of Colchicine on the Microscopic and Submicroscopic Structure of the Mitotic Spindle") with a polarization microscope indicate that spindle fibres seen in cytological preparations may not after all be artifacts.

The increased interest in the chemistry and physiology of the gene should not lead one to conclude that further advances in cytology and genetics along the classical lines have come to a stop. In a very thought-provoking article ("Interrelations between the Nucleus and Cytoplasm: Problems at the Biological Level") Schultz analyses some of the basic problems. Proof for the linear order of genes is afforded by the test of crossing over and as such it was assumed that crossing over takes place only between genes. Loci formerly thought to be single have turned out to be quadruple. Subgenes are visualized. The behaviour of the nucleus during tissue differentiation continues to remain intriguing. There is differential multiplication of chromosomes when cells become endopolyploid. It is possible that different rates of reproduction of heterochromatic and euchromatic regions of chromosomes may be responsible for the activation of specific genes during tissue differentiation.

The volume has justified the hope of the organisers. It affords a picture of the present position in the several divergent fields and offers indications for future lines of research. It would be a valuable addition to any library.

M. K. SUBRAMANIAM.

Blood Cells and Plasma Proteins. Edited by James L. Tullis. (Academic Press Inc., New York), 1953. Pp. xxii + 436. Price \$ 8.50.

This volume is the second in the series of memoirs of the University laboratory of physical chemistry related to medicine and public health of Harvard University, and has resulted from the deliberations in seminars dealing with

the intricate problems of blood cells and plasma proteins and their state in nature. Many brilliant investigators in this field have presented their findings and, to Dr. James L. Tullis must go the full credit for arranging the material available in such an excellent manner. The different contributions in the book have been divided into seven general categories. In the first section, comprising four chapters, Dr. E. J. Cohn, the doyen of investigators in this particular field, has dealt most appropriately with the discovery, characterization and separation by virtue of their physical properties and chemical interaction, of the various formed and fluid constituents of human blood. In the next section, the complex factors concerned with blood coagulation are discussed in five chapters by several authors, while the components of human blood concerned with immunity are dealt with in the third section by Dr. Janeway and others. Two further sections deal with erythrocytes and leucocytes, and particular mention may be made here of Dr. Denstedt's article for the remarkable presentation of new and thought-provoking data on the enzymology of the erythrocyte. The sixth section on plasma enzymes has been adequately covered by Dr. Surgenor and his colleagues, while in the final section on lipoproteins of blood and other tissues, there are a number of interesting articles such as lipoproteins of human plasma and linkages between proteins and lipids. It is gratifying to note that, in this volume, the vast amount of literature on blood cells and plasma proteins which has hitherto remained scattered in a number of publications has been assembled for the first time in such a manner as to give a co-ordinated and clear picture of the present status of the subject. It should, therefore, appeal to every one who is interested in either the components of blood cells or the characteristic behaviour of the plasma proteins.

P. S. SARMA.

Text-Book of Physics for the B.Sc. Students, Part I. (*Mechanics, Properties of Matter, Wave Motion, Sound and Light*). Pp. xiii + 451. Part II. (*Heat, Electricity and Magnetism*). Pp. xii + 509. By Snehahamay Datta (A. Mukherjee & Co., Calcutta), 1952. Price Rs. 7-8-0.

As a text-book meant for the use of the students of the Pass Course in B.Sc. of our Universities, the appearance of these volumes will be welcomed. They cover the syllabus completely and are very well produced. Besides the usual questions and problems on the text, there is also a summary at the end of each

chapter, which is bound to be very useful to the student. The volumes are well illustrated and adequately indexed.

Challenge of the Unknown. By Louis K. Ans-pacher. (George Allen & Unwin, Ltd., London), 1952. Pp. 324. Price 16 sh.

Dr. Ans-pacher was associated with Professor Hyslop for many years in the early stages of the American Society for Physical Research, and his book may well serve to introduce readers to the growing mass of information on occult phenomena. The case for psychics is here presented with many examples of telepathy and clairvoyance, which were compiled after years of investigation. The fascinating story of the Elberfold horses, which are said to have solved mathematical problems that baffled many experts, is also presented here in popular form. The book will be read with profit by all those interested in the study of the paranormal and the extra-sensory perceptions which perhaps define the boundary between the known and the unknown.

Books Received

The Chemistry of Heterocyclic Compounds; Condensed Pyridazine and Pyrazine Rings. By J. C. Simpson. (Interscience Publishers, Inc.), 1953. Pp. xvi + 394. Price \$12.50.

Crystal Structures. By Ralph W. G. Wyckoff. (Interscience Publishers, Inc.), 1953. Section III, Price \$14.50. Supplement II, Price \$4.00.

Principles of Electronics. By H. Buckingham and E. M. Price. (Cleaver-Hume Press), 1953. Pp. 335. Price 15 sh.

Small Transformers and Inductors. By K. A. Macfadyen. (Chapman & Hall), 1953. Pp. xii + 237. Price 37 sh. 6d.

The Atomisation of Liquid Fuels. By E. Giffen and A. Muraszew. (Chapman & Hall), 1953. Pp. ix + 246. Price 36 sh. net.

An Introduction to Qualitative Chemical Analysis. By A. V. Katti. 1953. Pp. ix + 89. Price Rs. 2.

Advances in Veterinary Science, Vol. I. Edited by C. A. Brandly and E. J. Jungherr. (Academic Press), 1953. Pp. xi + 317. Price 37 sh. 6d. net.

Nutrition in India. By V. N. Patwardhan. ("The Indian Journal of Medical Sciences", Bombay 4), 1952. Pp. viii + 345. Price Rs. 10.

Technique of Organic Chemistry, Vol. VIII. (Investigation of Rates and Mechanisms of Reactions). Edited by S. L. Friess and A. Weissberger, 1953. Pp. xxiii + 760. Price \$12.50.

SCIENCE NOTES AND NEWS

Chemical Control of Nut Grass *Cyperus rotundus* L.

Messrs. C. Thakur and H. N. Singh, Central Sugarcane Research Station, Bihar, report that chemical control of nut grass, a pernicious perennial weed, can be obtained by means of the commercial weedicides—fernoxone (containing 80 per cent. sodium salt of 2, 4-D: 0.125 per cent. and 0.25 per cent. concentration), phenoxylene 30 (Pest Control Ltd., Cambridge: 0.33 per cent. and 0.66 per cent. concentration), and 2, 4-D (2, 4-Di-chlorophenoxyacetic acid: 0.5 per cent. and 1.0 per cent. concentration—at the rate of 100 gallons per acre. Of these, the former two were found to be more effective than 2, 4-D. Plants in blossoms resisted the effect of chemicals in all cases to a greater extent than non-flowering plants. In the lower dosage slight yellowing was noticed in some plants and they recovered very soon to the normal condition. The after-effects of these chemicals will be reported in detail later. Grateful acknowledgement is made to Sri. K. L. Khanna for providing necessary facilities for work.

Equipment for Raman Spectroscopy

Messrs. Hilger & Watts Ltd., London, have designed a spectrograph which facilitates the employment of Raman effect in industry and in research. The equipment consists of: (1) source unit, (2) large aperture, two-prism spectrograph with alternative cameras, (3) direct recording equipment, (4) scanning attachments, (5) vibrator, photomultiplier, amplifier, oscillator and supply unit. The equipment is sensibly linear over the whole of the operating range.

New Derivatives of Cortisone

Both cortisone and hydrocortisone occur naturally in the vertebrate adrenal cortex, and, as is well-known, are being used in treating rheumatoid arthritis, rheumatic fever and many other diseases. By means of the rat liver glycogen test, an assay used in evaluating compounds for cortisone-like activity, Drs. A. Borman and P. M. Singer of the Squibb Laboratories, U.S.A., established that three of the new halo-derivatives prepared by them approach cortisone in activity, while two exceed it.

One of the compounds, 9- α -chloro-17- α -hydroxycorticosterone, was shown to be found

four times as active as cortisone. This is significant since in the past authorities in the field have held it unlikely that substances more active than cortisone could be synthesized in the laboratory. Meanwhile the new compounds are being tested with laboratory animals and full evaluation must await clinical trials.

Synthesis of Hydrazine by New Method

Hydrazine—the basis of rocket fuels and the new anti-T.B. drug *Isoniazid*—has been synthesized by a new process developed in the U.S.A. The starting material is ammonia or urea. Using a high frequency discharge to keep heating effects to a minimum, the method yields 4.6 g. of hydrazine per kWh. of energy dissipated in the discharge tube. High flow rates through the discharge tube, small discharge currents, low pressures and small electrode gap distances favour yields.

Weather in the Upper Atmosphere

A new meteorological station has been established near Crawley, in Sussex, with automatic radar-sonde equipment for observing accurately the weather in the upper atmosphere. The equipment used was evolved directly from the existing radio-sonde system and is designed to meet the greater accuracy demanded of meteorological forecasting.

A radar transmitter-receiver, or transponder, is carried aloft by a free balloon and is interrogated automatically by radar pulses from the ground station. The height at which soundings can be made is limited largely by the bursting point of the balloon. The radar-sonde equipment is capable of operating at a ceiling height of at least 100,000' and wind speed and direction, temperature, pressure and humidity can be measured at ranges of up to 100 nautical miles. The balloons are released from the ground station at certain internationally agreed times and signals are received from the transponders by an automatic following aerial at the ground station. The whole process of recording, computing and telemetering is automatic.

New Monochromator

A new monochromator, developed by Fischer Scientific Co., U.S.A., gives high intensity monochromatic light of any desired frequency. The heart of the monochromator is its certified-

precision plane diffraction grating, ruled 600 grooves per mm. The monochromator has an efficiency of 65 per cent. at a wavelength of 265 m μ in the first order. The grating is mounted so that its full first-order spectrum is swept across the exit slit by a screw drive, which is turned by a drum graduated directly in m μ .

Streptohydrazid for T. B.

The Tuberculosis Chemotherapy Trials Committee of the British Medical Research Council announced recently that the best treatment now available against T.B. is a combination of the isoniazid (INH), with streptomycin. The dosage is 1 g. of streptomycin and 200 mg. of isoniazid daily.

It is now possible to give both these drugs—in almost exactly these proportions—in a single injection, for they have been chemically combined into one substance. This combination, called streptohydrazid, also helps to avoid the unpleasant stomach upsets and other side-effects which sometimes occur when isoniazid is given by mouth.

Symposium on Milk and Milk Products

It is proposed to hold a symposium on recent progress in biochemical research on milk and milk products, under the joint auspices of the Society of Biological Chemists, India, and the Indian Dairy Science Association, during the Easter recess of 1954. Those intending to take part in the symposium may please contact the Hon. Secretary, Society of Biological Chemists, India, Indian Institute of Science, Bangalore 3, or the Joint Secretary, Indian Dairy Science Association, Indian Dairy Research Institute, Bangalore.

Ophthalmology Institute

The Government of India have sanctioned Rs. 1,30,000 for construction of an Institute of Ophthalmology for post-graduate studies and a recurring grant of Rs. 20,000 for its maintenance in Aligarh. The Institute will be attached to the Gandhi Eye Hospital and will operate in collaboration with the Aligarh University.

Pharmaceutical Committee

A Committee has been appointed by the Government of India to undertake a comprehensive enquiry into the pharmaceutical industry. Among other things, the Committee is to study the operations of foreign concerns and Indian concerns with foreign associations. A questionnaire has been circulated to the industry calling for details about price structure and imports of raw and semi-processed materials.

Research Degree Awards

The Andhra University has awarded the Degree of Doctor of Science in Biochemistry (Medical), to Mr. B. Naganna for his thesis entitled "Pyro-Phosphates".

The University of Madras has awarded the Ph.D. Degree in Physics to Mr. Gopinath Kartha for his thesis entitled 'Studies on X-Ray Crystal Structure Analysis'.

Rajasthan Academy of Sciences, Pilani

Office-bearers for 1953-54: *President*: Dr. P. Nilakantan, *Vice-Presidents*: Dr. K. M. Gupta, Dr. A. K. Chatterji, Prof. M. L. Schroff, Dr. M. L. Roonwal, Dr. G. S. Mahajani; *Secretary*: Prof. K. Ramamurti; *Treasurer*: Prof. Roshan Singh.

Standards of Isotopes

For some time past, the need has been felt for absolute standards for radioactive isotopes. As the National Physical Laboratory, England, has at present the main responsibility for standards of certain radioactive isotopes in Great Britain, it is proposing to issue standards of these isotopes at regular intervals to meet the needs of those whose use of such materials justifies absolute standards and to supplement the normal calibrations which can be obtained on request from the Atomic Energy Research Establishment, Harwell. Standards of iodine-131, based on the British Standard for this isotope, will be issued on or about October 15, 1953. Future issues will take place twice yearly in mid-April and mid-October. The iodine-131 standards will be in the form of sealed ampoules of solution. Two different levels of activity will be available, one of 1 millicurie in 1 ml. of solution and one of 100 microcuries in 4 ml. of solution. Issues of standards of phosphorus-32 (100 microcuries in 4 ml. of solution) are planned to take place on June 15 and December 1, 1953. Applications for these standards should reach the National Physical Laboratory not later than a fortnight before the appropriate date of issue, and should include a statement of the purposes for which the standards are required. A fee of £ 10 will be charged for each 1 millicurie standard and of £ 5 for each 100 microcuries standard. It is requested that applicants should make their own arrangements for the collection of their standards from the laboratory. An announcement relating to the issue of cobalt-60 standards will be made in the near future.

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CENTRAL ELECTRONICS ENGINEERING RESEARCH INSTITUTE, PILANI

THE Foundation-Stone of the Central Electronics Engineering Research Institute, Pilani, was laid by the Prime Minister, Shri Jawaharlal Nehru, on September 21, 1953. The institute is the fourteenth in the chain of national laboratories set up by the Council of Scientific and Industrial Research all over India, and will fill a lacuna in one of the basic fields of modern scientific research in our country.

During the last two decades and particularly during the last World War, electronic research has progressed at a rapid rate and there is no field of science or industry that has not been aided by electronic research. Electronics has played a notable part in the developments which took place during the war for the radio location of aircrafts and submarines. Electronic machines are employed to solve complicated equations and save much laborious calculation. In industry, electronic equipment has been used to melt metals, case-harden them, heat plastics and control chemical processes. Electronics is also responsible for rapid strides in the field of radio communication and television. In a word, the development of electronics has become of fundamental importance both from the

point of view of theoretical research and the application of its results to practical affairs.

Against this background of developments in other countries India unfortunately has little to show. Research in radio and electronics has been confined only to a few centres like the Calcutta University Institute of Electronics, the National Physical Laboratory, New Delhi, and the Tata Institute of Fundamental Research, Bombay. These centres cannot, however, meet all our needs. There was not only scope but an urgent necessity to set up an institute specialising in this vast field.

The Pilani Institute owes its origin to an offer made by Mr. G. D. Birla in 1950, to donate Rs. 21 lakhs on behalf of the Birla Education Trust for the purpose of establishing a research institute at Pilani. This offer was considered by the Governing Body of the CSIR and it was decided that the establishment of an institute which would have as its objective advanced training and research in electronics, should receive the highest priority. It was decided that the institute should be located at Pilani, and that a capital expenditure of Rs. 25 lakhs on buildings and equipment and a recurring expenditure of Rs. 5 lakhs per year should be

set apart towards its establishment. The Government of India, recognising the national importance of the proposed institute, have made a provision of Rs. 29 lakhs for the institute in the First Five-Year Plan.

The object of the institute will be to undertake research and development on all aspects of electronics engineering. Special attention will be devoted to the utilisation of indigenous raw materials in the manufacture of components, development and use of electronic circuits for industry, building of standard electronic instruments for test purposes, investigations on radar and other types of equipment, and applications of electronics in metallurgy. The institute will undertake projects sponsored by industry and close liaison will be maintained between the institute and industry.

The institute will consist of the following divisions: Electronic Circuits; Electronic Components; Electronic Instruments; Acoustics and Audio Equipment; Ultra-High Frequency and Very High Frequency Equipment; Library, Information and Workshop.

Investigations which will be taken up to start with in the different divisions will include the following: circuits for process control in industry; designs for high frequency generators; high and low power transmitters, communication receivers, amplifiers and other equipment; high dielectric ceramics, ceramic capacitors and electrolytic capacitors; carbon resistances and volume control equipment; thermionic valves; tungsten wire drawing and coating; standard signal generators, wave form generators, short-

wave generators; valve testers and bridges; harmonic analysers; cathode ray oscillographs, Geiger-Muller and scintillation counters; frequency standards; electro cardiograph; loud-speakers, microphones, pick-ups and other acoustic equipment; radio-location apparatus; aircraft and ground receiving and transmitting equipment; and radio controls.

The institute will be under the overall direction of a Director, and the total staff in all categories is expected to be 350 when the institute is fully developed. The Birla Education Trust have acquired, on behalf of the Council of Scientific and Industrial Research, 701 Bighas of land at a cost of Rs. 1,43,000 for the institute.

The total floor area required for housing the various divisions of the institute will be 1,40,000 sq. ft. The main building, which will be a multi-storyed structure, with a floor area of 40,000 sq. ft., will house the testing laboratory, standards rooms, library and administrative offices. The technological block, with a floor area of 100,000 sq. ft., will provide room for the workshop, pilot plants, heavy machinery, furnaces and presses. In the first stage of development, the built-up floor space will be 20,000 sq. ft. in the main building and 45,000 sq. ft. in the technological block. The capital expenditure in the second stage of development is estimated at Rs. 19.0 lakhs.

In extending our heartiest welcome to the institute, we also share the faith of the generous donor, Mr. G. D. Birla, that the institute has a great part to play in building the India of the future.

CLASSIC COLLECTION OF INDIAN PLANTS AT LIVERPOOL

THE rediscovery of a famous collection of Indian plants, which appear to have been lost sight of for about a century, is described by Mr. H. Stansfield, Keeper of Botany in the City museums, Liverpool, in a recent issue of the *North Western Naturalist*.

He records that recently the Liverpool museums were given the whole contents of the museum of the Liverpool Chemists' Association—a collection founded in 1856. Among the things received was a herbarium of several thousand plants of whose history nothing was known. Examination of such clues as localities, dates and handwriting has, however, established beyond doubt that the focus of the collection was Saharanpur in the foothills of the Himalayas, that the period was the years 1823-34, and that the collector was Dr. John Forbes Royle, F.R.S. (1799-1858), at that time a surgeon in the service of the East India Company. In 1837, Royle became Professor of

Materia Medica at King's College, London. He was active in promoting the great Exhibition of 1851 and was at one time Secretary of the British Association.

In 1839 Royle published an important two-volume work, *Illustrations of the Botany of the Himalayan Mountains*, and *The Flora of Cashmere* and the herbarium just rediscovered proves to contain many of the "type specimens" of species first described in that book. Moreover, the plants are accompanied by a number of pencil and water-colour drawings which are the originals of the plates. Additional value is given to the specimens because they were known to Sir J. D. Hooker, who cited many of them in his great *Flora of British India*. The herbarium has suffered some damage and loss in the past century, but Mr. Stansfield believes that about 80 per cent. of Royle's plants are still there and in fairly good condition.

ON THE IMPORTANCE OF THE MID- AND UPPER TROPOSPHERIC THERMAL SYSTEMS IN THE DEVELOPMENT OF WEATHER IN NORTH-EAST INDIA AND EASTERN PAKISTAN DURING THE NOR'WESTER SEASON

C. RAMASWAMY AND B. L. BOSE

The Airport, Calcutta

IN a recent issue of this Journal, the present authors¹ had pointed out that extensive and destructive nor'westers in West Bengal and Eastern Pakistan and the adjoining areas of Orissa, Bihar and Assam are invariably associated with cold pools or cold thermal troughs at the 500 mb. level and that the actual outbreak of nor'westers is preceded 18-24 hours ahead by the development of these thermal systems not only at the 500 mb. level but also possibly at the 300 mb. level. It was also shown by the authors that cold-advection associated with these systems appeared to be the final determining factor in the outbreak of the nor'westers. In view of the obvious importance of this subject, the authors have pursued this problem further by an analysis of the 500 and 300 mb. partial thickness patterns for the whole of May 1953. This period was characterised by exceptionally severe nor'wester activity during the first half of the month and by unusually fair weather during the last ten days. Thus the authors had an excellent opportunity of getting during the course of one month, two distinct types of weather situations in North-East India and Eastern Pakistan. For purpose of this study, the partial thickness charts were prepared in the same way as was done in the earlier investigation. For the reasons stated in the earlier paper, more weightage was given to the thermal winds than to the Radio-sonde thickness values while drawing the thickness lines. Special attention was given, while drawing the lines, to the *principle of continuity in space and time*—a point which has been so rightly emphasised by Petterson² and Priestley. In regions where data were wanting, due attention was also paid to the normal partial thickness patterns* in the same way as the normal upper winds are taken into account while drawing upper wind stream lines on constant level upper wind charts in regions of sparse data. The thunderstorms which were reported (thunder heard was also taken as thunderstorm for this purpose) between 03 GMT of

the next day and 03 GMT of the following day were plotted on the 500 mb. chart to bring out conspicuously the association between the thunderstorms and the thermal systems.

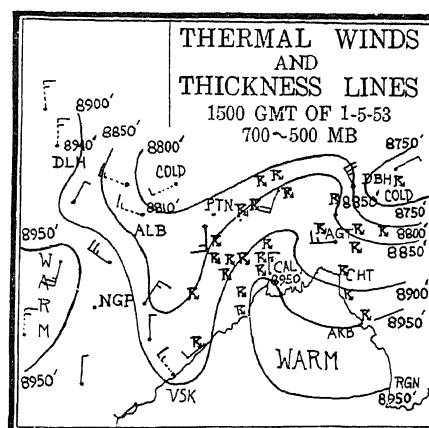


FIG. 1

The study of the charts thus prepared and analysed has not only confirmed the results presented in the earlier paper but has also brought to light a number of new points of interest which are briefly stated below:

(i) A very large proportion of the thunderstorms in North-East India and Eastern Pakistan during the month, irrespective of their spatial distribution and intensity, were associated with a cold thermal trough or cold pool at the 500 mb. level except where orography had played an important part. The thunderstorms (irrespective of their intensity) lay mainly in the eastern half of the cold thermal system. It was interesting to find that, out of a total number of 438 thunderstorms in North-East India and Eastern Pakistan during May 1953, as many as 311 thunderstorms (i.e., 70 per cent. of the total) occurred to the east of the thermal trough line while only 127 thunderstorms (i.e., only 30 per cent.), occurred to the west of the thermal trough line.

(ii) The cold thermal troughs (or cold pools) at the 500 mb. level persisted generally for 2 or 3 days with varying intensities and shifting their positions eastwards or westwards during the period. With the shifting of the thermal systems and with the changes in their intensities,

* These are being published separately. They also show strikingly the association between the 500 mb. partial thermal patterns and the normal monthly distribution of thunderstorms in North-East India and Eastern Pakistan in March, April and May.

the regions of development of the thunderstorms and the number of thunderstorms also correspondingly changed. The thickness charts for the 5th, 6th and 7th May 1953, and the development of thunderstorms on the respective following days may be quoted as examples.

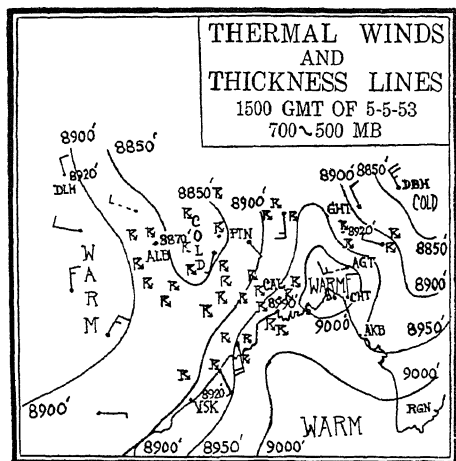


FIG. 2

(iii) On account of paucity of data, it was not possible to establish that the thunderstorms were always associated with a cold trough at the 300 mb. level also. However, sufficient evidence was available to show that, on days of widespread thunderstorms, a cold trough was present at the 300 mb. level also, the thermal trough line at this level running to the west of the thermal cold line or (to the west of the centre of the cold pool) at the 500 mb. level. The partial thickness charts for the 300 mb. level for 1st, 5th and 8th May 1953 may be cited as examples.

(iv) A warm ridge at the 500 mb. level was unfavourable for the development of thunderstorms while a warm ridge at the 300 mb. level over a cold trough at the 500 mb. level seemed to inhibit the development of these thunderstorms. During the last ten days of May 1953 which were characterized by unusually fair weather over North-East India and Eastern Pakistan, a warm high with varying positions on different days, lay over the Bay of Bengal north of Lat. 16° N. at the 500 mb. level with an associated warm ridge frequently extending into Orissa, Chotanagpur and Gangetic West Bengal. Normally, this warm high lies over the Andaman Sea and the adjoining parts of Central Bay of Bengal as can be seen from the normal patterns referred to earlier. The effect of this

warm high on the weather over North-East India and Eastern Pakistan during the last ten days of May 1953 can be best illustrated by the developments over Gangetic West Bengal on the 25th, 26th and 27th. On all these three days, the usual synoptic charts and constant level upper wind charts below 10,000' indicated the possibility of thundersqualls over Gangetic West Bengal. But nothing actually happened on the 25th and 26th and even on the 27th, only a few overhead thunderstorms without surface squalls occurred. The reason for this was that, on the 24th evening, the warm ridge referred to above, was affecting Gangetic West Bengal, Chotanagpur and Orissa at the 500 mb. level. The ridge gradually began to recede from Gangetic West Bengal on the 25th and was replaced by a weak cold trough by the 26th evening resulting in a few thunderstorms without surface squalls over that region on the following day.

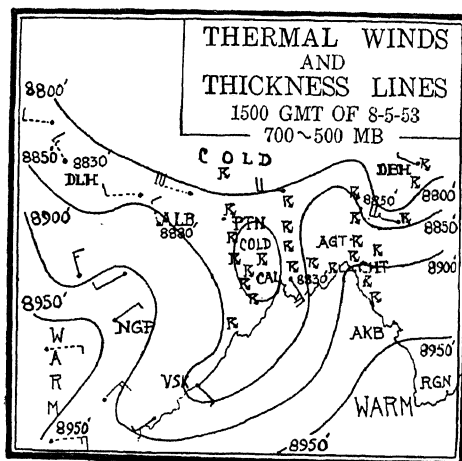


FIG. 3

(v) Other conditions being the same, a confluent thermal jet[†] seemed to increase thunderstorm activity.

(vi) The vital importance of the mid- and upper tropospheric cold thermal systems in the development of nor'wester squalls was strikingly brought out in a number of cases in this investigation also. For instance, on the morning of 4th, 9th, 14th and 18th,† the sea-level

† On the 4th, Jamshedpur experienced a squall of 90 m.p.h. On the 9th, the Calcutta Airport had a record squall of 86 m.p.h. On the 14th, squalls were widespread over Gangetic West Bengal and caused damage in most of the districts. On the 18th, according to Press Reports, a motor launch capsized at Munshiganj (Dacca Dist.) as the result of a severe nor'wester squall and 125 persons on board the launch lost their lives.

charts, constant level upper wind charts below 10,000' and the subsidiary charts showed more or less the same features as on other days when few or no thunderstorms developed in the respective regions (e.g., compare the charts for the 9th and 14th with those for the 8th and 28th respectively). In contrast to this, on every one of these occasions, the partial thickness charts for the 500 mb. level showed well-marked cold troughs or cold pools close to the region where the thundersqualls developed. The situation on the 14th May 1953 deserves special mention. Even a forecaster who believed in "taking no risks", would have predicted on this day on the basis of the usual charts, only a few thunderstorms over this division. And yet, on this evening, severe thundersqualls developed over every district in the division.

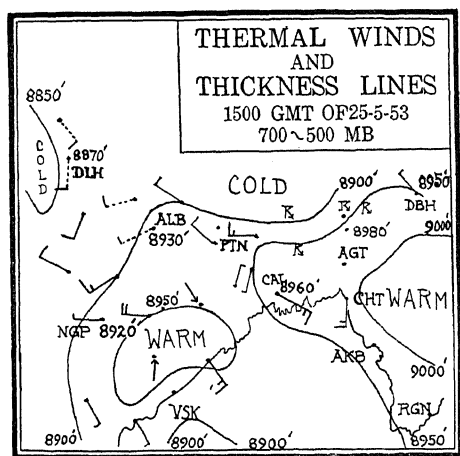


FIG. 2

Figs. 1-4 show the partial thickness charts at the 500 mb. level on a few interesting situations and the thunderstorms which occurred between 03 GMT of the next day and 03 GMT of the following day (*vide* para 1 above). Fig. 1 (1-5-1953) shows the asymmetric development of the thunderstorms with respect to cold troughs and also how two cold troughs can each produce its own set of thunderstorms. Note the ENE, 5 knots thermal wind over Dibrugarh, NNW, 25 knots thermal wind over Tezpur and westerly 15 knots thermal wind over Agartala, clearly indicating a cold trough over Assam.†

† The thickness value at Shillong was obviously too high compared to its value on the previous day and the following day. Hence it was suitably corrected,

The absence of thunderstorms over the central districts of Eastern Pakistan where a warm ridge exists, is interesting. It would also appear that North Orissa and the adjoining parts of Gangetic West Bengal were in a confluent thermal jet and that the comparatively greater concentration of thunderstorms in that region could, to some extent, be attributed to this additional factor.

Fig. 2 (5-5-1953) shows the inhibiting effect of a warm pool. Note the widespread thunderstorms in the cold trough and the conspicuous absence of thunderstorms in East Pakistan where the northerly thermal winds over Chittagong, southerly thermal winds over Jalpaiguri and west-south-westerly thermal winds over Agartala clearly suggest the existence of a warm area.

Fig. 3 (8-5-1953) shows the thermal situation which led to a record squall of 86 m.p.h. at the Calcutta Airport. The most interesting feature of this case is the south-south-east thermal wind (based on radar wind at 15.00 GMT) of 20 knots over Calcutta between 700 and 500 mb. levels‡ (i.e., roughly between 10,000' and 20,000'). The thermal wind between 15,000' and 20,000' worked out to as much as 150°, 32 knots!

Fig. 4 (25-5-1953) illustrates the inhibiting effect of a warm ridge at the 500 mb. level. The complete absence of even thunder over Gangetic West Bengal and Chotanagpur on this day in spite of the favourable lower level conditions is highly significant.

The question may be asked whether the time lag observed between the appearance of the thermal system and the subsequent weather developments has any theoretical justification. The answer to this must await further studies which are in progress. However, J. S. Sawyer⁴ has published isopleths of thermal vorticity and relative divergence in certain specific situations and the actual weather developments at sea-level 12 hours and 24 hours later. These seem to support the idea that

‡ The radiosonde thickness value at Calcutta was too high. It had to be corrected to maintain continuity with respect to the previous day's pattern, to avoid unjustifiable crowding of thickness lines to the west of the cold pool, to fit in the westerly thermal wind over Chittagong and south-south-easterly thermal wind over Calcutta and to avoid undue deviation from the normal thickness pattern in North Bay of Bengal where the normal partial thermal winds are between SSW and WSW in May.

there can be an appreciable time lag as have been observed by us. Also C. K. M. Douglas⁵ has found that the cold pools are especially important in European regions for forecasting beyond 24 hours. In view of these, the time lag observed in the case of nor'westers over North-East India and East Pakistan need not cause surprise. On the other hand, we can go forward with the hope that the time lag, what-

ever be its cause, should be of great value in predicting these thundersqualls.

1. Ramaswamy, C. and Bose, B. L., *Curr. Sci.*, 1953, 22, 103. 2. Petterson and Priestley, *Det Norske Meteorologiske Institutt, V. T. M.*, 1946, No. 2. 3. Sutcliffe and Forsdyke, *Quart. Jour. Roy. Met. Soc.*, 1950, 76, 189. 4. Sawyer, J. S., *Centenary Proceedings, Roy. Met. Soc.*, 1950, 107. 5. Douglas, C. K. M., *Met. Magazine*, 1947, 76, No. 904, 225.

PSYCHOLOGY OF EXCELLENCE

A COMMENT that might be made on contemporary psychology both by other scientists and by our colleagues in the humanities is that in its necessary concern with average and subaverage people it has given too little direct attention to those who are outstanding for excellence of some kind. This forms the topic of Prof. D. W. Harding's address this year to Section J (Psychology) of the British Association. It seems important to understand the conditions of excellent achievement, since general progress commonly occurs through advances made by unusual people and gradually followed up by the social group as a whole. The relation between outstanding people and the rest of us is part of the broader question of relations between people of different levels of ability or quality of mind. Waste of human resources occurs through the obstruction or neglect suffered not only by the very great but also by many people of more moderate excellence, including gifted children whose potentialities have not been discerned, and may excel those of their teachers and parents.

Two broad problems concern the psychologist: first, that of the mere perception of excellence, especially excellence surpassing one's own; secondly, that of the response to perceived excellence, whether it excites, for example, generous admiration or jealousy and attempted disparagement. A good relation between people of differing levels of ability depends on the attitude of the abler as well as that of the less able person. If the latter is to maintain his self-respect and psychological security he must feel that the other recognizes the value of his contribution, however small, to the common

task; and recognizes his equality as a person, however subordinate his function may be. The ability to convey to subordinates one's recognition of their equality as persons is one mark of good leadership, and the basis of it deserves more attention from psychology. In some activities (for example, in amateur games and sports) the perception of excellence is aided by objective assessments of performance, and response to it is so controlled by usage and convention that good relations are maintained between people of widely contrasting levels of ability. When less objective performances and more intangible qualities are in question, the difficulties of assessing oneself in comparison with others become formidable and various.

We know rather little at present, not only about the recognition of excellence in others, but even about the psychological processes involved in making an advance ourselves and recognizing that our own present standards are higher than those we once accepted. Many of the unanswered psychological questions in this field are the concern of the social and experimental psychologist; others invite the aid of the psychopathologist, for example, the effect of the child's view of his parents and the effect of sibling jealousy on his later attitudes to greatness and superior achievement in others. Any direct psychological study of the conditions governing the achievements of distinguished people, whole minds may far excel those of the psychologists who undertake it, must raise special problems of technique which have up to the present received comparatively little attention.

(—By courtesy of *Nature*.)

THE JAISINGH OBSERVATORIES*

THIS first publication of the Jaipur Astronomical Society, founded in 1948, deals with the history and achievements of Jaisingh II, the founder of Jaipur, who lived in the stormy and unstable period when the Moghul Empire was going to pieces after Aurangzeb. Jaisingh played his own part in the various military campaigns which were so widespread at the time, and was a consummate diplomat who succeeded in carving out for himself a sizable kingdom; but posterity knows him best as a great builder and as the designer of the impressive masonry instruments of odd design in Delhi (1724), Jaipur (1734), Ujjain, Banares and Muttra, of which all are in existence except the last. The vernier was not in existence at that day, and finding brass instruments too small for sufficient accuracy, he constructed the Delhi instruments of his own invention, of stone and lime of perfect stability, graduated to read up to 2 seconds of arc in some cases.

Jaisingh was well versed in the Hindu *Surya-siddhanta*; he had studied Euclid through a Persian translation, and was conversant with the observations of Ulugh Beg, a grandson of Timur the Lame, in his observatory at Samarkand (1425). He sent scholars abroad both to the Muslim world and to Europe to get the latest astronomical tables. He devoted several years to daily observations of the stars and planets, and the results of these were set out in the form of tables in his book *Zij-i-Muham-mad Shahi* dedicated to the Emperor Muhammad Shah. It is a tragedy of Indian Astronomy that the work of Tycho Brahe, Kepler and

Newton (whose *Principia* was published when Jaisingh was a baby one-year-old) never reached India in time to influence its development.

The first chapter of the book deals with historical material and the second with intellectual influences. The third chapter is devoted to introductory astronomy, while the fourth and last chapter deals with Jaisingh's astronomical instruments. These include the "Nari Valaya Yantra", the "Samrat Yantra" (a huge equinoctial sun-dial)—the masterpiece of Jaisingh,—the "Rasi Valaya Yantra", a group of 12 instruments to read directly the longitude of the sun, the "Digamsa Yantra" and "Ram Yantra" to read the azimuths of celestial objects, the "Jai Praksh" and "Kapali", to read spherical co-ordinates directly, the "Dakshinavritti Yantra", which is a transit circle, the "Shast-hamsa Yantra" for reading the declination of the sun at noon, the "Misra Yantra", and the three instruments in brass, the "Chakra Yantra", "Kranti Vritti Yantra" and the "Yantra Raj", the last one being essentially an astrolabe. There are 20 pages of plates including a portrait of Jaisingh II, and of his manuscripts, and of the various instruments mentioned above. The book is printed on art paper and is attractively get up.

A most welcome publication on an interesting subject.

A. NARASINGA RAO.

* *Maharaja Sawai Jaisingh II of Jaipur and his Observatories*, By M. F. Soonawala, Jaipur Astronomical Society, Jaipur, 1952, pp. vi + 44.

PROGRESS OF BOTANY IN INDIA, BURMA AND CEYLON

THE INDIAN BOTANICAL SOCIETY has appointed the following specialists to compile a report on the progress made in various aspects of Botany in India, Burma and Ceylon. The compilation will be published and circulated by the UNESCO. Co-operation of every worker in the field is solicited by the Society in view of the extensive nature of the project. A list of publications with full titles, reference to journals in which published and a brief resume of each paper should be sent by the authors directly to the compilers concerned preferably before the end of October. Heads of departments and institutions can render a valuable service by sending such lists for the past and the present associates.

(1) Algæ—(a) South India and Ceylon: Prof. M. O. P. Iyengar, 71, V. R. Pillai Street, Madras; (b) North India: Prof. Y. Bharadwaja, Dept. of Botany, Banaras Hindu University; (2) Mycology and Plant Pathology—

Prof. S. N. Das Gupta, Dept. of Botany, University of Lucknow; (3) Bryophyta—Dr. S. K. Pande, Reader in Botany, University of Lucknow; (4) Pteridophyta—Dr. T. S. Mahabale, Botany Dept., Institute of Science, Bombay; (5) Gymnosperms and Embryology—Prof. P. Maheshwari, Dept. of Botany, University of Delhi; (6) Palæobotany—Dr. A. R. Rao, Reader in Botany, University of Lucknow; (7) Wood Anatomy—Dr. K. A. Chowdhury, Wood Technologist, Forest Research Institute, Dehra Dun; (8) Floral Anatomy—Dr. V. Puri, Dept. of Botany, Meerut College, Meerut; (9) Systematic Botany—Fr. H. Santapau, St. Xavier's College, Bombay; (10) (a) Physiology—Dr. K. N. Lal, College of Agriculture, Banaras Hindu University; (b) Ecology—Dr. R. Misra, Department of Botany, University of Saugar; (11) Genetics and Cytology—Dr. P. N. Bhaduri, Indian Agricultural Research Institute, New Delhi.

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ABSORPTION SPECTRUM OF
3-CHLORO-THIONAPHTHENE

FOLLOWING the work of Viswanath¹ on molecules containing six- and five-membered rings, the spectrum of 3-Chloro-Thionaphthene is photographed under different experimental conditions, in the region λ 3000 to λ 2755. This molecule belongs to the C symmetry class and the spectrum represents the allowed electronic transition $A''-A'$. The spectrum resembles closely, in general appearance, that of thionaphthene. It presents a typical group pattern as in thionaphthene. Whereas an alternation in the intensity of the components of each group is observed in thionaphthene, the bands in each group, in this case, show a gradual fall in intensity from violet to red. Viewing the spectrum as a whole, there is a rapid fall in intensity of absorption from red to violet, unlike the gradual fall recorded in thionaphthene.

From an analysis of about 90 red-degraded bands, the following upper state frequencies are identified :

177, 680, 763, 968, 1025, 1213 and 1321.

The 0, 0 band is located at ν 33733 and shows a shift of 327 cm^{-1} to the red from that of thionaphthene.

Full details will be published elsewhere.

Physics Department, K. SREERAMAMURTY.
Andhra University, P. B. V. HARANATH.
Waltair, July 30, 1953.

1. Viswanath, G., *Thesis for Doctorate of Andhra University*, 1953.

BETA ACTIVITY OF In^{109} *

THE isotope In^{109} having a half life of 5 hours was first produced by Tendam and Bradt¹ by the (α , 2n) reaction from Ag^{107} . It was subsequently verified by the present author² who

measured its excitation function with α -particles having energies upto 40 Mev, using the 60-inch Berkeley cyclotron. Tendam and Bradt¹ had reported the emission of positrons with an end point of about 2 Mev from this isotope. Mal-lary and Pool,³ however, did not observe this positron group in the decay of In^{109} . Instead they observed a positron group with an end point of 0.75 Mev in the decay of this isotope.

The radiations emitted by this isotope were studied by the present author with a magnetic lens β -ray spectrometer.[†] Besides the conversion electrons from the 203 kev γ -ray emitted by In^{109} , reported by McGinnis,⁴ a number of positron groups were observed. The Kurie plots of the positrons are shown in Figs. 1 & 2. They represent the positrons emitted from two thin silver foils ($< 10 \text{ mg./cm.}^2$ thick) bombarded by α -particles with energies of 21 Mev and 37 Mev respectively. The 1.7 Mev positron in Fig. 2 belongs to the well-known isotope In^{110} , having

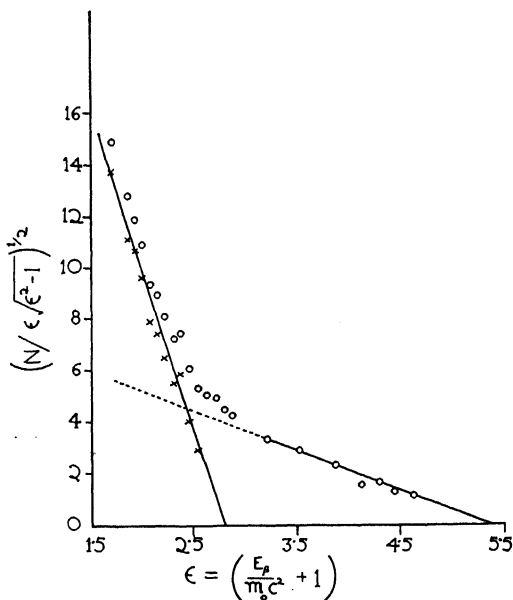


FIG. 1. Kurie plot of the positrons emitted from silver foil bombarded by α -particles of energy 21 Mev. The positrons have end points at 0.9 Mev and 2.2 Mev.

a half life of 65 minutes, produced by Ag^{109} (α , 3n) reaction. Its appearance only at the higher α -energy and not at the lower α -energy agrees with the excitation function for the production of this isotope by the α -bombardment of silver.²

The positrons of 0.9 Mev end point in Fig. 1 and of 0.94 Mev end point in Fig. 2 are prob-

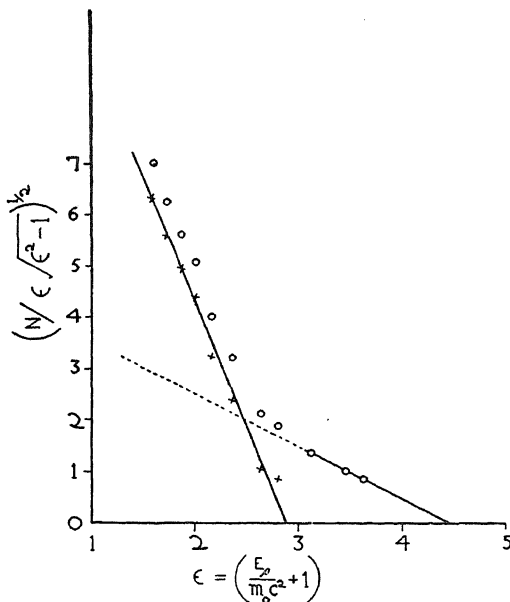


FIG. 2. Kurie plot of the positrons emitted from silver foil bombarded by α -particles of energy 37 Mev. The positrons have end points at 0.94 Mev and 1.7 Mev.

ably the same, the difference between them being within limits of experimental error. Chemically this activity belongs to indium. It has a half life of about 3-5 hours, comparable to the known half life of In^{109} . Further, its relatively large yield at the lower α -energy of 21 Mev (Fig. 1), as compared to the yield at $E_\alpha = 37 \text{ Mev}$ (Fig. 2), conforms to the behaviour of the yields of reactions involving the emission of two particles from such medium heavy nuclei.² Thus, it seems reasonable to ascribe the 0.9 Mev positron activity to In^{109} produced by Ag^{107} (α , 2n) reaction.

The 2.2 Mev. positron group also belongs to an indium isotope, and has a half life between 3-5 hours. As can be seen from the above figures, it appears in the silver foil bombarded with 21 Mev α -particles and not in the foil bombarded with 37 Mev α -particles. This behaviour of the yield of the isotope emitting the 2.2 Mev positron is similar to that of the isotope emitting the 0.9 Mev positrons. Since the half life agrees, we ascribe the 2.2 Mev positrons also to In^{109} produced by Ag^{107} (α , 2n) reaction, in agreement with Tendam and Bradt.¹

The author wishes to express his sincere gratitude to Professor Emilio Segrè for his interest and guidance. Thanks are also due to the

60-inch cyclotron crew of the University of California, Berkeley.

Dept. of Physics,
Lucknow University,
July 13, 1953.

S. N. GHOSHAL.

* This work was done in 1950 at the University of California, Berkeley, California, U.S.A.

† The author is indebted to Professor A. C. Helmholz and Dr. R. Hayward for kindly permitting the use of their β -ray spectrometer.

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FORCE CONSTANTS FOR THE BF_3 MOLECULE

A 'NORMAL CO-ORDINATE' treatment using Wilson's¹ F-G matrix method is adopted for the determination of the force constants for the BF_3 molecule. Assuming a plane symmetrical model and a valence force field for this molecule, the following P.E. expression has been derived.

$$2V = f_a (\Delta d_1^2 + \Delta d_2^2 + \Delta d_3^2) + d^2 f_a (\Delta a_1^2 + \Delta a_2^2 + \Delta a_3^2) + 2f_{aa} (\Delta d_1 \Delta d_2 + \Delta d_1 \Delta d_3 + \Delta d_2 \Delta d_3) + 2df_{aa} [(\Delta a_1 + \Delta a_3) \Delta d_1 + (\Delta a_1 + \Delta a_2) \Delta d_2 + (\Delta a_3 + \Delta a_2) \Delta d_3] + 2d^2 f_{aa} (\Delta a_1 \Delta a_2 + \Delta a_1 \Delta a_3 + \Delta a_2 \Delta a_3)$$

where f_a and f_a are the stretching and bending force constants respectively. f_{aa} , f_{aa} and f_{aa} are the three interaction force constants. The value of f_a is determined from Badger's rule.² The remaining four force constants are derived by using the three known frequencies (480.4, 888 and 1445.9 cm^{-1}) of the planar vibrations of B^{11}F_3 from Raman and Infra-red data.³ Two sets of force constants are obtained and are given in Table I. f_a and f_{aa} could be obtained only as a difference. The first set of the force constants are utilised in calculating the corresponding frequencies of the isotopic molecule B^{10}F_3 . These are compared in Table II with the observed values. The agreement is satisfactory and indicates the correctness of the above calculations.

TABLE I
Values of the force constants
($k \times 10^5$ dynes/cm.)

| | I Set | II Set |
|------------------|-----------------|--------|
| f_a | .. 7.099 | |
| | (Badger's rule) | |
| f_{aa} | .. 0.867 | |
| f_{aa} | .. -0.2052 | 6.077 |
| $(f_a - f_{aa})$ | .. 0.3352 | 1.814 |

TABLE II
Frequencies of B^{10}F_3 in cm^{-1}

| Calculated | Observed |
|------------|----------|
| 888 | 888 |
| 1499 | 1497 |
| 497 | 482 |

The details of the calculations will be published elsewhere.

Andhra University, (Miss) V. SANTHAMMA.
Waltair, August 24, 1953.

1. Wilson, Jr. E. B., *J. Chem. Phys.*, 1939, **7**, 1047; *Ibid.*, 1941, **9**, 76; Crawford, Jr. B. L., *Ibid.*, 1941, **9**, 69. 2. Badger, Richard, M., *Ibid.*, 1935, **3**, 710. 3. Herzberg, *Infra-Red and Raman Spectra of Polyatomic Molecules*, 1945, p. 299.

RELATION OF VIBRATION FREQUENCIES OF MONO-SUBSTITUTED BENZENES TO THOSE OF BENZENE

GENERALISED correlations applicable to mono-substituted benzenes, $\text{C}_6\text{H}_5\text{X}$ (where X is an atom or a group of atoms), have been derived¹ from a recent investigation on the spectra of benzaldehyde² and toluene. Molecules with $X \geq 15$ (on atomic weight scale) are dealt with and are supposed to belong (at least approximately) to C_{2v} symmetry. Teller-Redlich product rule has been used to check all the assignments and to derive equations for three of the frequencies of benzene.

| Species of C_{2v} | Frequency ³ of benzene | Frequency of mono-substituted benzene |
|----------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a_1 | $\nu_6 b_{1u}$ 1008 ⁴ | $\nu_6' a_1$ constant at $\sim 780 \text{ cm}^{-1}$ |
| | $\nu_{15} e_{2g}$ 3047 | $\nu_{15}' a_1$ valence vibration of the atom linked to phenyl group. It is $\sim 1200 \text{ cm}^{-1}$ when a C atom is linked to phenyl group. |
| | $\nu_{18} e_{2g}$ 606 | $\nu_{18}' a_1 = 1980 \cdot \sqrt{(1/X) + (1/78)} \text{ cm}^{-1}$ (compared with observed in Table I) |
| | Others | Practically unchanged. |
| b_1 | $\nu_{3a} a_{2g}$ 1190 ⁴ | $\nu_3' b_1 < 400 \text{ cm}^{-1}$ represented by an equation (compared with observed in Table I). If X is a group of atoms, $\nu_3' b_1$ splits into two. |
| | Others | Practically unchanged. |
| | $\nu_{20} e_{2u}$ 404 | $\nu_{20}' b_2$ constant at $\sim 470 \text{ cm}^{-1}$ |
| b_2 | $\nu_{11} e_{1g}$ 849 | $\nu_{11}' b_2 < 300 \text{ cm}^{-1}$ represented by an equation (compared with observed in Table I). If X is a group of atoms, $\nu_{11}' b_2$ splits into two. |
| | Product of all others | Practically unchanged. |
| a_2 | All | Nearly the same. |

TABLE I

Comparison of observed and calculated values of a few frequencies of some mono-substituted benzenes

| Molecule | Weight of X | $\nu_{18}'a_1$ | | $\nu_{11}'b_1$ (in-plane bending) | | $\nu_{11}'b_2$ (out-of-plane bending) | |
|-------------------|-------------|----------------|------|--------------------------------------|-----------|------------------------------------------|-----------|
| | | Obs.* | Cal. | Cal. | Obs. | Cal. | Obs. |
| Toluene | 15 | 521 | 558 | 397 | 407, 344. | 277 | 294, 216. |
| Aniline | 16 | 529 | 543 | 390 | 385, . | 273 | , 233. |
| Phenol | 17 | 528 | 530 | 384 | , 367. | 270 | , 235. |
| Fluorobenzene | 19 | 517 | 506 | 372 | , 367. | 264 | , 242. |
| Benzonitrile | 26 | 460† | 448 | 346 | 380, 314. | 251 | 270, 173. |
| Benzaldehyde | 29 | 440 | 431 | 338 | 328, 281. | 247 | 249, 140. |
| Chlorobenzene | 35 | 417 | 403 | 326 | 295. | 241 | 195. |
| Benzotrifluoride‡ | 69 | 338 | 327 | 295 | 321, 235. | 226 | 199, 140. |
| Bromobenzene | 80 | 315 | 315 | 291 | 250. | 224 | 181. |
| Iodobenzene | 127 | 267 | 285 | 280 | . | 219 | 168. |

* Most of these assignments are taken from Sponer and Teller, *Rev. Mod. Phys.*, 1941, **13**, 75, where it has been denoted by ω_8'' . † Bass, *J. Chem. Phys.*, 1950, **18**, 1403, gives 548 cm.⁻¹, but is not quite sure (see his discussions). However, 460 is a stronger frequency in absorption, fluorescence and Raman spectrum. ‡ M. L. N. Sastry, Thesis, Duke University, Durham, 1951; see also *J. Chem. Phys.*, 1952, **20**, 1428.

Full details of the procedure adopted are under publication¹ and the significance of the above-mentioned equations (and of other results) as regards the electronic structure will be published elsewhere. Comparison between theory and experiment is shown in Table I.

The author is thankful to Dr. R. K. Asundi for valuable discussions.

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Banaras Hindu University,
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DIFFRACTION OF LIGHT BY SUPERPOSED ULTRASONIC WAVES— A THEORETICAL STUDY

ASYMMETRY in diffraction of light at normal incidence by superposed ultrasonic waves of frequencies exactly in the ratio of 1:2 was first observed by B. R. Rao¹ and theoretically interpreted by a suitable extension of Raman and Nath's simplified theory.² The present communication extends this theoretical treatment to the generalised case of diffraction by

two superposed waves of frequencies in any integral ratio 1: n and having any phase difference Δ . Expressions have been obtained for the two specific cases of even and odd values of n .

For the case of even ratio of frequencies 1: $2k$, the amplitude expression for the even order $2m$ is given by

$$P \frac{\sin(ul - 2mb) P/2}{(ul - 2mb) P/2} \left[\sum_{s=0}^{\infty'} J_{2(sk-m)}(v_1) \right. \\ \left. J_s(v_{2k}) e^{-is\Delta} + (-1)^s \sum_{s=0}^{\infty''} J_{2(sk+m)}(v_1) J_s(v_{2k}) e^{+is\Delta} \right] \\ + P \frac{\sin(ul + 2mb) P/2}{(ul + 2mb) P/2} \left[(-1)^s \sum_{s=0}^{\infty} J_{2(sk-m)}(v_1) \right. \\ \left. J_s(v_{2k}) e^{+is\Delta} + \sum_{s=0}^{\infty''} J_{2(sk+m)}(v_1) J_s(v_{2k}) e^{-is\Delta} \right]$$

where $J_s(v_{2k})$, etc., are the Bessel functions. The other symbols have the same significance as in reference 1. The double dash over the summation sign indicates that the coefficient of $J_0(v_1)$, $J_0(v_{2k})$ is one-fourth that of others and the coefficient of $J_l(v_1)$, $J_s(v_{2k})$ is half that of the other terms.

An examination of the expressions in the square brackets shows that they are not equal in magnitude for any arbitrary value of Δ which indicates asymmetry in diffraction. However, when $\Delta = \pi/2$ it can be seen that the expressions are identical, thus establishing symmetry in the diffraction pattern. Similar expressions

obtained for the odd orders also showed the same behaviour.

When the frequencies are in any odd integral ratio $1:2k+1$, the amplitude expression for even order $2m$ is given by

$$P \frac{\sin(u \pm 2mb)}{(u \pm 2mb)P/2} \left[(-1)^s \sum_{s=0}^{\infty} J_{[s(2k+1)-2m]}(v_1) \right. \\ \left. J_s(v_{2k+1}) e^{\mp i s \Delta} + (-1)^s \sum_{s=0}^{\infty} J_{[s(2k+1)+2m]}(v_1) \right. \\ \left. J_s(v_{2k+1}) e^{\pm i s \Delta} \right]$$

It can be easily seen that the intensity expressions for the positive and negative orders are identical for all values of Δ , thus establishing symmetry in the diffraction pattern.

Summation of the wave forms, by graphical methods, confirms these results qualitatively. Numerical calculations have been made for obtaining the intensities of diffraction spectra for the special cases of two waves of frequencies in the ratio $1:3$ and for three different phase angles of 0 , $\pi/2$ and π . A qualitative experimental confirmation of these results is also obtained in the case of diffraction by two sound waves of frequencies in the ratio $1:3$. Further details will be published elsewhere.

My grateful thanks are due to Dr. B. R. Rao, for suggesting me this problem and for his valuable guidance during the progress of this work.

Dept. of Physics, J. SATYANARAYANA MURTY,
Andhra University,
Waltair, September 17, 1953.

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MAGNETISATION CURVES FOR FERRUGINOUS MANGANESE ORES

THE manganese ores of the Vizag District have been mostly thrown as waste, as they contain a low percentage of manganese, although there are many ways of beneficiating the ores.¹ One economic way of beneficiation of these ores is by the use of the alternating current magnetic separators. This method of magnetic separation of these ores has been under investigation in the Geophysical Laboratories of the Andhra University and the following studies are presented as a preliminary.

Accordingly ferruginous manganese ore samples from two localities (a) Garividi, and (b) Garbham (Vizag District) were collected and chemically analysed for total iron and manganese percentages.

The effects of grain size and percentage composition on the magnetic properties of these

ore samples were studied. Four fractions of different grain sizes and six fractions of different percentages of the ore from Garividi and five fractions of different grain sizes and four fractions of different percentages of the ore from Garbham were studied.

The apparatus used for the measurement of hysteresis was that of Dr. Bruckshaw and B. S. R. Rao.² The I and H curves for all the nineteen fractions were drawn at a peak field of 375 oersteds and the magnetic properties were read from these curves. The detailed results will be shortly published elsewhere, but they are summarised below: (1) The permeability decreases as the field strength increases, (2) The coercive force increases with decrease in particle size, (3) The remanence increases with particle size, and (4) With packing density, the remanence and the intensity of magnetisation both show an increase. The above results are in conformity with those of the earlier workers.³

The dependence of the coercive force on the grain size has been shown earlier by the dispersion theory⁴ of magnetic hardening and also by the magnetic measurements of Nagaoka⁵ on iron amalgam. The decrease in coercive force with increase in grain size demonstrated by the present investigation is another direct experimental proof of the dispersion theory.

The observation of the relations of heat treatment and chemical composition to magnetic properties of these ores is under investigation and the results will be published later.

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Andhra University,
Waltair, August 1, 1953.

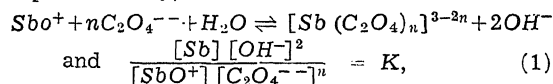
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OXALATE COMPLEX OF TRIVALENT ANTIMONY

THE solubility of antimony oxide in solutions containing potassium oxalate and oxalic acid in proportions $1:1$ at 25°C ., $2:1$ at 27°C ., $4:1$ at 30°C . and $8:1$ at 30°C . is determined. The number of oxalate ligand in the oxalate complex of antimony is deduced from the solubility data and pH of the solutions by the method adopted by Edmonds and Brinbaum.¹ The

equilibrium constants at three different temperatures are obtained and consequently the change in free energy, heat of reaction and change in entropy are calculated.

It is assumed that antimonyl ions present in the solution of antimony oxide² react with a number n of oxalate ligand and the reaction is represented by,



where the symbols have the usual meaning, and the activity coefficients are assumed to be unity. The product of antimonyl ion and hydroxyl ion has been determined² to be 7.7×10^{-18} ; hence,

$$[\text{Sb}][\text{OH}^-]^3 = K \times 7.7 \times 10^{-18} [\text{C}_2\text{O}_4^{--}]^n. \quad (2)$$

If in one set of experiments the ratio of oxalate to oxalic acid is kept fixed, the pH of the solutions after equilibrium is found to be constant. The above equation can be written as follows, if pH is constant:

$$\log [\text{Sb}] = \log K_1 + n \log [\text{C}_2\text{O}_4^{--}]. \quad (3)$$

By plotting $\log[\text{Sb}]$ against $\log[\text{C}_2\text{O}_4^{--}]$ straight lines would be obtained where the slope would give the value of n .

The total antimony and the total oxalate, together with total antimony, are determined by standard potassium bromate and potassium permanganate solution respectively. The concentration of the complex is determined by subtracting the solubility of antimony² (5.8 g. atom per 1,000 g. of water) from the total antimony. The total oxalate in the solution $[\text{Ox}]$ is equal to the concentrations of oxalic acid bioxalate ion, oxalate ion and the oxalate present in the complex $n[\text{Sb}]$. Taking the first and second dissociation constants of oxalic acid to be k_1 and k_2 respectively, it can be shown that,

$$[\text{Ox}] - n[\text{Sb}] = \left[\frac{[\text{H}^+]^2}{k_1 \cdot k_2} + \frac{[\text{H}^+]}{k_2} + 1 \right] \times [\text{C}_2\text{O}_4^{--}] = k_3 [\text{C}_2\text{O}_4^{--}] \quad (4)$$

$[\text{H}^+]$ being constant. As a first approximation, $n[\text{Sb}]$ is neglected; whence

$$[\text{C}_2\text{O}_4^{--}] \approx \frac{[\text{Ox}]}{k_3}$$

Equation (3) can be written as

$$\log [\text{Sb}] \approx \log K_2 + n \log [\text{Ox}]$$

By plotting $\log[\text{Sb}]$ against $\log[\text{Ox}]$, very nearly straight lines are obtained; the value of n is nearly 2. The value of n is taken as 2 and from Equation (4), the value of $[\text{C}_2\text{O}_4^{--}]$ is calculated. When $\log[\text{Sb}]$ is plotted against $\log[\text{C}_2\text{O}_4^{--}]$, straight lines are obtained in all the four cases and the value of n is again 2.

Substituting the value of n and appropriate concentration in Equation (2), the equilibrium constant is obtained at three different temperatures. The results obtained are given below.

| Temp. ° C. | $\text{K}_2\text{C}_2\text{O}_4 : \text{H}_2\text{C}_2\text{O}_4$ | No. of expts. | Mean value of $K \times 10^{13}$ | ΔF_0 in k. cal. | ΔH_0 in k. cal. | ΔS_0 in cal. per degree |
|------------|-------------------------------------------------------------------|---------------|----------------------------------|-------------------------|-------------------------|---------------------------------|
| 25 | 1 : 1 | 13 | 2.493 | 17.18 | | |
| 27 | 2 : 1 | 6 | 4.974 | 16.89 | 59.54 | 142 |
| 30 | 4 : 1 | 6 | 13.21 | 16.47 | | |
| 30 | 8 : 1 | 6 | | | | |

The high positive value of ΔS_0 is due to ring formation on chelation.³ The co-ordination number of antimony in this complex $\text{Sb}[\text{C}_2\text{O}_4]_2^-$ is 4. The 4d and 5s levels are completely filled up, hence are not available for bond formation. Most probably, three 5p, one 5d orbitals are used for bond formation, as in the case of tellurium tetrachloride.⁴

Full details of the investigation will be published elsewhere.

Dept. of Chemistry,
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Cuttack-3, March 30, 1953.

A. C. NANDA.
S. PANI.

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THERMODYNAMICS OF SOLUTIONS OF VOLATILE SOLIDS

In a recent communication,¹ Srivastava and Rastogi developed a generalized thermodynamic theory of multi-component systems based on Gibb's method and deduced a modified Clausius-Clapeyron relation for any solution of non-electrolyte. For a binary ideal liquid mixture, the variables T , the pressure P and the composition are related by the equation:

$$- \frac{N_1' L_1^\circ + N_2' L_2^\circ}{T} \cdot dT + \frac{RT}{P} \cdot dP = RT \left(\frac{N_1'}{N_1} - \frac{N_2'}{N_2} \right) dN_1 \quad (1)$$

where N' and N are the mole-fractions in the vapour phase and solution phase respectively. The subscripts 1 and 2 refer to the two components of the solution and L_1° and L_2° are the

respective heats of evaporation of the pure components. For isobaric processes, equation (1) yields :

$$\left(\frac{dN_1}{dT}\right)_P = - \frac{N_1' L_1^\circ + N_2' L_2^\circ}{RT^2 \left(\frac{N_1'}{N_1} - \frac{N_2'}{N_2}\right)} \quad (2)$$

These and other relations have been subsequently verified for certain binary and ternary liquid mixtures by Rastogi and Srivastava.

For solid solutions of volatile solids, we can easily obtain the analogous relations,

$$- \frac{N_1' L_1^s + N_2' L_2^s}{T} \cdot dT + \frac{RT}{P} \cdot dP = RT \left(\frac{N_1'}{N_1} - \frac{N_2'}{N_2}\right) dN_1 \quad (3)$$

and

$$\left(\frac{dN_1}{dT}\right)_P = - \frac{N_1' L_1^s + N_2' L_2^s}{RT^2 \left(\frac{N_1'}{N_1} - \frac{N_2'}{N_2}\right)} \quad (4)$$

where L_1^s and L_2^s are the heats of sublimation of respective components.

For testing equation (3), the data of Vans-tone³ for solid-vapour equilibrium of borneol-camphor were used. Details will be reported elsewhere, but the principal data are given in Table I.

TABLE I

| N_1 | N_1' | $T^\circ K$ | L_1^s cal./g. mol. | L_2^s cal./g. mol. | dP (obs.) | dP (cal.) |
|-------|--------|-------------|-------------------------|-------------------------|-------------|-------------|
| .6 | .4312 | 390 | 13110 | 12840 | 22.0 | 22.91 |
| .4 | .2363 | 380 | „ | „ | 16.5 | 16.9 |
| .4 | .2750 | 405 | „ | „ | 34.0 | 37.82 |

The agreement between observed and calculated values of dP is as good as could be expected, considering the accuracy of measurements. The above results also confirm that the systems considered are approximately ideal. Similar type of agreement is observed for the system β -naphthol-naphthalene for which the data of Spornaski⁴ was used. Equation (4) is also verified for these systems.

Of particular interest are the equilibrium properties of liquid solution of volatile solid solute, which have so far received very little attention. For them, equations (1) and (2) remain still valid. The equilibrium data over a wide concentration and temperature range are not available and hence it is not possible to test equa-

tion (1). However, equation (2) is of considerable interest in studying the boiling point elevations in liquid solutions of volatile solutes, such as camphor and naphthalene, etc. Beckmann,⁵ using his measurements, has calculated the molecular weights of such solutes by the approximate relation of van't Hoff, viz.,

$$\left(\frac{dN_1}{dT}\right)_P = - \frac{N_1 L_1^\circ}{RT^2} \quad (5)$$

which is the particular case of (2) when $N_2' = 0$. The molecular weights calculated by him are too high, indicating that the systems may not be ideal. The data of Beckmann has been re-examined here in the light of equation (2). The value of $\left(\frac{dN_2}{dT}\right)$ has been calculated from equation (2) by assuming that the solutions obey Raoult's Law. These, together with the values calculated from approximate equation (5), are compared with the observed values in the following table.

TABLE II
Carbon disulphide—camphor system

| N_2 | Elevation in boiling- point | $\left(\frac{dN_2}{dT}\right)_P$ from eq. (5) | $\left(\frac{dN_2}{dT}\right)_P$ from eq. (2) | $\left(\frac{dN_2}{dT}\right)$ (obs.) |
|---------|-----------------------------------|--------------------------------------------------|--------------------------------------------------|------------------------------------------|
| .005072 | 0.151 | .03117 | .03298 | .03414 |
| .01 | 0.290 | .03098 | .03433 | .03493 |
| .02023 | 0.585 | .03063 | .03476 | .03447 |
| .03888 | 1.127 | .02995 | .03557 | .03570 |
| .06660 | 1.890 | .02891 | .03642 | .03610 |

It is seen that only the values calculated from the corrected equation correspond closely with the observed values, thereby showing that the system considered is ideal. Similar type of agreement is also observed for the system carbon disulphide-naphthalene.

The detailed paper will be published elsewhere. The author is indebted to Prof. A. C. Chatterji and B. N. Srivastava, F.N.I., for helpful discussions.

Dept. of Chemistry,
Lucknow University,
Lucknow, July 6, 1953.

R. P. RASTOGI.

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STEATORRHOEA IN NUTRITIONAL
OEDEMA

THE stools of the patients suffering from nutritional oedema were noticed to be rather uniform in appearance: they were whitish, porridgy to watery in consistency, quite bulky and very offensive. Since they possess the characteristics found in steatorrhoea, fat balance studies were undertaken.

Six patients suffering from nutritional oedema were subjected to the investigations. They were placed on a standard diet, the fat composition of which was calculated from dietary tables.¹ The food offered to the patients were accurately weighed and if any significant amount was left after a meal, it was reweighed and subtracted from the ration. After the patients were on such a diet for a period of 5-7 days, stools were collected over 24-hourly periods. The fatty acids in the stools were estimated by the method of Kamer, Huinink and Weyers² and total fat calculated. In the results reported here only mean of the values obtained for the stool samples in three consecutive days are given.

On admission to the hospital, the following results were obtained on six such patients:

| Case No. | Fatty acids (% of stool weight) | Total amount of fatty acids (24 hrs.) | Fat excre- tion in % of fat intake |
|------------|---------------------------------------|---------------------------------------------|------------------------------------------|
| 1 P.N.D.G. | 2.7 | 16.7 g. | 30 |
| 2 M.B. | 2.5 | 22 g. | 21 |
| 3 U.R. | 4.6 | 16 g. | 30 |
| 4 J.B. | 7.1 | 25 g. | 33 |
| 5 B.G. | 3.6 | 36 g. | 30 |
| 6 B.G.R. | 4.6 | 22 g. | 26 |

The corresponding values for normal persons as calculated from data given in the literature^{3,4} are 3.3 per cent. fatty acids, 5 g. total fat and a fat excretion amounting to 4 per cent. of intake. These figures are in close agreement with those found for normal persons in our control tests.

From the table, it appears that there is a considerable impairment of the fat absorption in patient's suffering from nutritional oedema.

It is interesting to note here that administration of pancreatic enzyme preparations (Festal,* Hoechst and Pantozyne, Wander) did not improve the fat absorption; no difference could be found between the fat excretion preceding the lipase administration and that during the oral administration of 15 Willstätter units (3 times daily).

When these patients' clinical conditions improve as shown by loss of weight, negative water balance, diminution of oedema, increase of serum proteins and reversal of the altered A : G ratio, their fat absorption also rises. As an illustration the patient No. 4 is presented in greater detail (Fig. 1). He remained after admission to the hospital for the first 7 weeks in a comparatively steady state; his serum protein⁶ varied between 4.8 g. and 4.6 g. with an albumen/globulin ratio of 1 : 1.4. The fat excretion was in three periods of estimation between 20-30 per cent. of the intake. It was then thought that the control period was sufficiently long to permit the evaluation of the effect of a specific treatment. 1,000 c.c. of an amino acid preparation† containing 50 g. of amino acids was infused

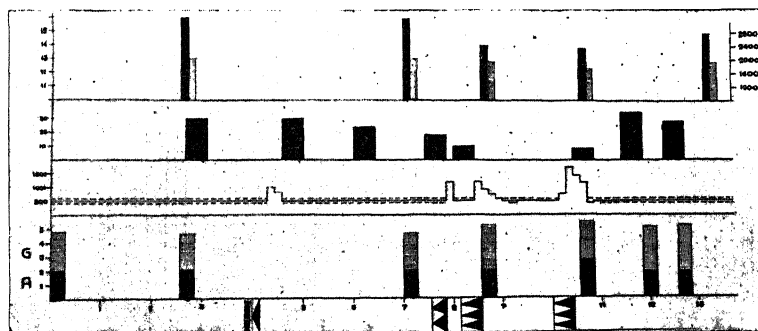


FIG. 1. Metabolic chart of patient No. 4: Abscissa: time scale in weeks, starting with admission to hospital. ◀ at the bottom indicate Parenamine—Infusions (each 1000 ml. per day).

Columns from bottom to top:

1. Serum protein (g. %); A = albumin, G = globulin.
2. Urine output in 24 hrs. (in ml.); dotted lines indi-

cate daily variation. 3. Fat excretion in % of intake (each column corresponds to the mean value obtained in 3 consecutive days). 4. Top row: black columns represent Thiocyanate space in l (scale on the left side), dotted columns represent circulating plasma volume in ml. (scale on the right side).

daily for five days. The estimation of the serum proteins now indicated an increase from 4.6 to 5.2 g. The thiocyanate space became reduced from 17.2-14.1 litres. The striking fact, however, was the alteration of the fat absorption. Only 6-10 per cent. of the fat taken in with the diet appeared in the stool which comes close to the figures obtained in control cases mentioned before. All the effects described became even more marked after another series of 3 amino acid infusions. Hardly 2 weeks later, however, during which no treatment was given besides a protein-rich diet, the total serum protein decreased again and at the same time a considerably increased amount of fat appeared in the stool; the consistency of the stools, however, remained more or less the same throughout the whole period of investigation.

This observation indicates that together with the increase or decrease of the serum protein level a corresponding alteration of fat absorption takes place; diarrhoea as such does not invariably lead to increased fat excretion as found by Cook *et al.*⁷ Principally the same relations were noticed in three other patients during their spontaneous recovery. A statistical evaluation of the data was performed with the aim to demonstrate a correlation between fat absorption and total serum protein level: 18 pairs of figures for total serum proteins and fat excretion in stools were available from our data, ranging from a serum protein level of 3.1 g. per cent. up to normal. A correlation coefficient of 0.897 was calculated which is statistically significant at a 0.01 per cent. level.

The collaboration of Dr. S. Ghosh, Bengal Chemical Research Fellow, who joined in the later stage of the investigation, is gratefully acknowledged.

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Calcutta, June 1, 1953. G. WERNER.§

* The amount of lipase in the Festal was estimated following the procedure of Willstätter⁵ and was found to correspond to the values given.

† Parenamine (Winthrop Stearns).

‡ May and Baker Foundation Fellow.

§ W. H. O. Professor of Pharmacology.

1. Bose, J. P., *A Handbook of Diabetes mellitus and Its Modern Treatment*, 1949 (U. N. Dhur & Sons, Calcutta), p. 191. 2. Kamer Vande, Huinink, H. Ten Bokkel and Weyers, H. A., *J. Biol. Chem.*, 1949, **177**, 347. 3. Fowweather, F. S., *Brit. J. Exper. Pathology*, 1926, **7**, 7. 4. Wollaeger, E. E., Comfort, M. W. and Osterberg, A. E., *Gastro-Enterology*, 1946, **6**, 83. 5.

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EFFECT OF CYSTEINE ON THE IN VITRO METABOLISM OF ALCOHOL BY LIVER AND BRAIN

DURING the course of experiments carried out in this laboratory on the effect of antabuse (Tetra-ethyl thiuramdisulphide) on the metabolism of alcohol by minced brain and liver suspensions, it was observed that the prior addition of cysteine hydrochloride reduced the acetaldehyde content of the reaction mixture after incubation for a period of 2 hours. It was apparent from this finding that cysteine counteracts the inhibitory effect of antabuse^{1,2} on the enzyme systems responsible for the metabolism of acetaldehyde.

The acetaldehyde contents of the incubated mixtures of (1) brain + alcohol, and (2) liver + alcohol were found to be significantly higher than in the corresponding incubated mixtures of (1) brain + cysteine HCl + antabuse + alcohol, and (2) liver + cysteine HCl + antabuse + alcohol. When cysteine was not added to the reaction mixture, and antabuse and alcohol only were incubated with brain and liver preparations, the acetaldehyde contents were considerably increased.

One gramme minced brain in 10 ml. water + 2 ml. of 4 per cent. alcohol were incubated at 37° C. for 2 hours in glass-stoppered flask. This was cooled to +5° C., deproteinised with 8 ml. of tungstic acid reagent and filtered at 5° C. 10 ml. of the filtrate were taken for acetaldehyde estimation. The same procedure was employed for other mixtures containing either antabuse or antabuse and cysteine. The results are given in Table I.

TABLE I

| | Acetaldehyde in µg. per gramme of brain/liver |
|---------------------------------------------------------------------|-----------------------------------------------------|
| 1 g. Brain + alcohol .. | 15.2 |
| 1 g. Brain + antabuse (50 mg.) + alcohol | 18.5 |
| 1 g. Brain + cysteine HCl (50 mg.) + antabuse (50 mg.) + alcohol | 10.0 |
| 1 g. Liver + alcohol .. | 30.0 |
| 1 g. Liver + antabuse (50 mg.) + alcohol | 43.5 |
| 1 g. Liver + cysteine HCl (50 mg.) + antabuse (50 mg.) + alcohol | 20.1 |

It is apparent from these results that cysteine hydrochloride not only counteracts the inhibitory action of antabuse on the metabolism of acetaldehyde but also accelerates the overall metabolism of alcohol. This conclusion was further confirmed by the following experiments.

Brain and liver preparations were incubated for 2 hours with cysteine hydrochloride and alcohol, and the acetaldehyde contents were determined. The results are given in Table II.

| | Acetaldehyde content in μ g. per gramme of brain/liver |
|---------------------------------------------------------------|---------------------------------------------------------------------|
| 1 g. Brain + 2 c.c. of 4% alcohol | 14.4 |
| 1 g. Brain + 50 mg. cysteine HCl + 2 c.c. of 4% alcohol | 8.3 |
| 1 g. Liver + 2 c.c. of 4% alcohol | 31.5 |
| 1 g. Liver + 50 mg. of cysteine HCl + 2 c.c. of 4% alcohol | 15.0 |

The alcohol dehydrogenase activity of liver is considerably greater than that of brain, as there is greater production of acetaldehyde in the liver suspension than in the brain suspension.

Of the many drugs so far examined, only dinitro-phenol and dinitro-cresol have been found to accelerate alcohol metabolism.^{3,4} However, very high and toxic doses of these compounds are necessary to demonstrate this effect.

It is of interest to determine whether it is possible or not to accelerate the alcohol metabolism in a person under the influence of alcohol without using dangerous drugs. The results obtained by us with cysteine hydrochloride appear to offer some promise in this direction.

This investigation is expected to be very useful for the alcoholics. If the alcohol metabolism can be accelerated, the cumulative toxic effects of alcohol can be considerably reduced and the hazards of alcohol intake minimized.

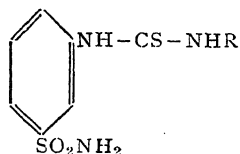
Investigations on the mechanism of the anti-alcoholic action of antabuse and the role of cysteine are in progress and the detailed results will be published shortly.

Central Drugs Laboratory, N. K. IYENGAR.
Government of India, H. BISWAS.
Calcutta-12, M. D. CHAKRAVARTI.
June 27, 1953.

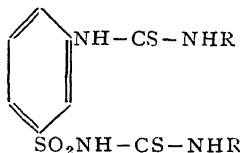
1. Jacobsen E. and Martensen-Larsen, O., *J. Amer. Med. Assoc.*, 1949, **193**, 918. 2. Hald, J., Jacobsen, E. and Larsen, V., *Acta Pharmacol et toxicol*, 1948, **4**, 285. 3. Harger, T. W. and Hulpiew, H. R., *J. Pharmacol and Exper The p.*, 1935, **54**, 145. 4. Newman, H. W. and Tentes, M. L., *Ibid.*, 1936, **57**, 67.

ANTIMALARIAL ACTIVITY OF SOME SUBSTITUTED THIOCARBAMIDE DERIVATIVES

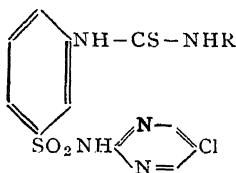
SOME substituted thiocarbamide derivatives of metanilamide^{1,2} (types A and B), metachloridine³ (type C) and sulphanilamide⁴ (type D) have been synthesised by one of us as possible chemotherapeutics and the details have been reported earlier. Representative members from each of the above four types of compounds have been tested for their antimalarial activity against blood-induced *P. gallinaceum* infections in chicken and the results of these preliminary screening tests are presented below:



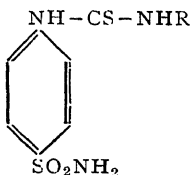
Type A



Type B



Type C



Type D

As the *P. gallinaceum* in the chick is the most convenient infection to use and as it is sensitive to all drugs so far discovered active in human malaria, the testing of these compounds have been done with this species of parasites.⁵ Young chicken of 2-3 weeks old and belonging to white leghorn or Rhode Island type were used for the above experiments. They were grouped into groups of three each, of equal weights. Blood from a parasitised bird was taken by cardiac puncture and was diluted with 2 per cent. citrate saline so as to contain 16×10^6 parasites per 0.1 ml. of blood. All the birds were injected into the pectoral muscle with 16 million parasites. Keeping one group

TABLE I

| Drug No. | Type | R | Parasites per 500 r.b.c. Days after inoculation | | | | | | | | | Remarks |
|----------|------|------------------------|----------------------------------------------------|----|-----|-----|-----|----|-----|----|----|----------------------------------|
| | | | 4 | 6 | 8 | 10 | 12 | 15 | 18 | 20 | 25 | |
| 419 | A | H | .. | 2 | 115 | D* | | | | | | No antimalarial activity |
| 421 | A | <i>p</i> -chlorophenyl | .. | 0 | 0 | 0 | 0 | 15 | 135 | D | | Very slight suppressive activity |
| 425 | A | <i>p</i> -tolyl | .. | 0 | 0 | 5 | 160 | D | | | | No activity |
| 426 | A | <i>p</i> -anisyl | .. | 10 | 25 | D | | | | | | do |
| 432 | A | <i>iso</i> -propyl | .. | 0 | 45 | 85 | D | | | | | do |
| 441 | B | <i>p</i> -chlorophenyl | .. | 0 | 5 | 50 | D | | | | | do |
| 442 | B | <i>iso</i> -propyl | .. | 0 | 30 | 115 | D | | | | | do |
| 467 | C | <i>p</i> -chlorophenyl | .. | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 30 | Marked suppressive activity |
| | | | | | | | | | | D | | |
| 481 | C | <i>iso</i> -propyl | .. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | Very marked suppressive activity |
| 462 | D | <i>p</i> -chlorophenyl | .. | 0 | 5 | 45 | D | | | | | No activity |
| 480 | D | <i>iso</i> -propyl | .. | 0 | 20 | 65 | D | | | | | do |
| | | CONTROL | .. | 0 | 15 | 50 | 140 | | | | | |
| | | | | | | D | | | | | | |

* D—Died

as the control, all the other groups were fed with the respective drugs twice daily, starting 4-5 hours after inoculation. 10 mg. of each of the drug per 100 g. body weight was fed orally in aqueous solution or in suspension for the respective groups and the treatment was continued for four days. Blood smears were taken from these birds from the fourth day after inoculation, stained with Giemsa or J.S.B. Stain and were examined for the parasite count. The compounds so tested together with the results of the screening are given in Table I.

The sulphanilamide derivatives are found to be inactive while the metanilamide derivatives have indicated slight activity. Further the introduction of a substituted thiocarbamyl residue at the N³-amino group of metachloridine has given relatively more active compounds.

Our thanks are due to Dr. K. P. Menon and Dr. B. H. Iyer for their keen interest.

Pharmacology Laboratory, R. RAMA RAO.
Indian Inst. of Science, K. V. VISWANATHAN.
Bangalore 3, A. S. RAMASWAMY.
August 12, 1953. M. SIRSI.

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A SYNTHESIS OF FLAVONE-6-CARBOXYLIC ACID

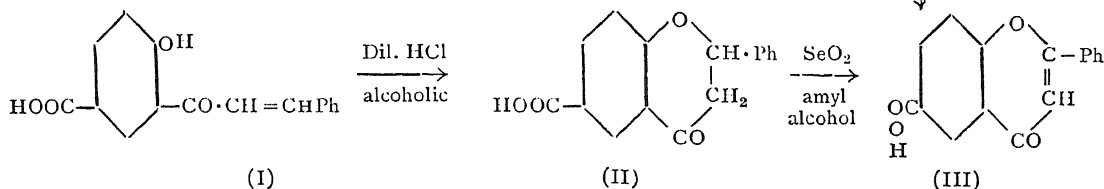
3-ACETYL-4-HYDROXY-BENZOIC ACID, now easily available by the Fries isomerisation of *p*-acetoxy-benzoic acid¹ as well as by the Friedel-Crafts reaction on *p*-hydroxy-benzoic acid, is an acid of much potential value for synthetic work. Its easy accessibility opens the way for synthetic preparation of heterocyclic compounds like chromones, flavones and other related compounds containing the carboxyl group by suitable reactions. As a part of the systematic study to synthesise such heterocyclics, the present work was undertaken and a synthesis of flavone-6-carboxylic acid is described here.

3-Acetyl-4-hydroxy-benzoic acid on condensation with benzaldehyde in presence of alkali (KOH) yielded the chalkone, 2-hydroxy-5-carboxy-phenyl-styrylketone (I) as bright yellow needles, m.p. 222°. It was isomerised to the flavanone (II) m.p. 235°, which on treatment with selenium dioxide in amyl alcohol gave flavone-6-carboxylic acid (III), m.p. 302°, which was also directly obtained by selenium dioxide treatment from the chalkone (I).

It may be noted here that the Kostanecki-Robinson acetylation of 3-acetyl-4-hydroxy-benzoic acid or its methyl ester did not succeed.

The work is being extended to the synthesis of other flavone-carboxylic acids.

SeO₂ and amyl alcohol



M. G. Science Institute,
L. D. College, Ahmedabad,
and

D. N. SHAH.

M. R. Science Institute,
Gujarat College, Ahmedabad,
July 25, 1953.

N. M. SHAH.

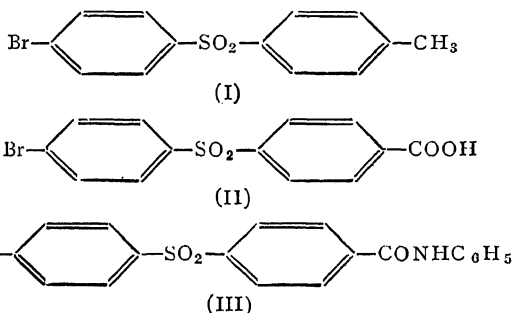
We are thankful to the Director of the Central Drug Research Institute, Lucknow, for having arranged to test the antibacterial properties of this compound.

Dept. of Chemistry, M. BALASUBRAMANIAN.
Annamalai University, V. BALIAH.
Annamalainagar,
August 27, 1953.

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p-(*p*-BROMOPHENYLSULPHONYL)- BENZANILIDE

SULPHONES have recently become of interest because of their potency in combating bacterial infections and other diseases like leprosy. In the course of an investigation on the synthesis of some sulphones of possible therapeutic value we had occasion to prepare *p*-(*p*-bromophenylsulphonyl)-benzanilide (III). The starting material for its synthesis was *p*-bromophenyl



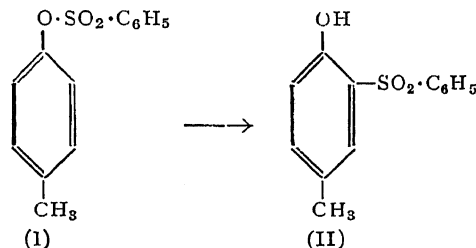
p-tolyl sulphone (I). Oxidation of (I) gave *p*-(*p*-bromophenylsulphonyl)-benzoic acid (II)¹ which was first converted to the acid chloride and then to the anilide (III), m.p. 217-19° (Found: C, 55.1; H, 3.4. C₁₉H₁₄O₃SNBr requires C, 54.8; H, 3.4 per cent.).

The sulphone (III) was examined for its antibacterial properties in the Central Drug Research Institute, Lucknow. It was tested against *Staphylococcus aureus*, *Escherichia coli*, *Eberthella typhi*, *Schigella paradysenteriae*, *Schigella dysenteriae*, *Vibrio cholerae* and was found to have superior antibiotic properties than sulphonamide.

1. Buehler, C. A. and Masters, J. E., *J. Org. Chem.*, 1939, **4**, 262.

THE ISOMERISATION OF ARYL SULPHONATES TO PHENOLIC SULPHONES

THE isomerisation of phenolic esters to phenolic ketones by means of anhydrous aluminium chloride was first noted by Fries and Finck.¹ Since then an extensive study of this reaction has been made by several workers and the reaction is referred to as the Fries reaction. The conversion of aryl sulphonates to phenolic sulphones by a similar method has not been much investigated. Simons, Archer and Randall² reported the formation of 2-hydroxy-5-methyldiphenyl sulphone (II) from *p*-tolyl benzenesulphonate (I) in 10 per cent. yield by heating the sulphonate in a closed copper bomb with hydrogen fluoride at 100° C. for 14 hours;



using ligroin as solvent. A method found by Rittler³ for the preparation of some hydroxy-diaryl sulphones consists in heating the sulphonate with aluminium chloride or zinc chloride in the presence or absence of an inert solvent like nitrobenzene. A modified procedure⁴ was subsequently developed by Rittler for the

TABLE I

| No. | Sulphonate | m.p. ° C. | Formula | Analyses, % | | | |
|-----|----------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------|--------------|------------|--------------|------------|
| | | | | Calcd. | | Found | |
| | | | | C | H | C | H |
| 1 | 2, 4-Dimethylphenyl benzenesulphonate | 132-33 | C ₁₄ H ₁₄ O ₃ S | 64.1 | 5.3 | 64.1 | 5.6 |
| 2 | Phenyl <i>p</i> -toluenesulphonate | 'o' 126-27 'p' 142-43 | C ₁₃ H ₁₂ O ₃ S C ₁₃ H ₁₂ O ₃ S | 62.9 62.9 | 4.8 4.8 | 63.0 63.2 | 4.9 4.9 |
| 3 | <i>p</i> -Tolyl <i>p</i> -toluenesulphonate | 130-32 | C ₁₄ H ₁₄ O ₃ S | 64.1 | 5.3 | 63.9 | 5.5 |
| 4 | <i>p</i> -Chlorophenyl <i>p</i> -toluenesulphonate | 125-26 | C ₁₃ H ₁₁ O ₃ ClS | 55.2 | 3.9 | 55.0 | 3.6 |
| 5 | <i>m</i> -Tolyl <i>p</i> -toluenesulphonate | 'o' 136-38 'p' 151-52 | C ₁₄ H ₁₄ O ₃ S C ₁₄ H ₁₄ O ₃ S | 64.1 64.1 | 5.3 5.3 | 64.2 64.0 | 5.1 5.5 |
| 6 | 2, 4-Dimethylphenyl <i>p</i> -toluenesulphonate | 129-30 | C ₁₅ H ₁₆ O ₃ S | 65.2 | 5.8 | 65.0 | 6.1 |

preparation of hydroxydiaryl sulphones. But for these few instances no attempts seem to have been made to prepare phenolic sulphones from aryl sulphonates. It was therefore thought desirable to undertake a more detailed investigation of this method of preparing phenolic sulphones.

In the present study some aryl sulphonates have been subjected to the action of anhydrous aluminium chloride. In contrast to the behaviour of phenolic esters, the isomerisation of sulphonates did not take place to any detectable extent at low temperatures. Heating at 80-160°C. was found to be necessary to bring about the isomerisation of aryl sulphonates to hydroxydiaryl sulphones. Whenever the sulphonate contained no substituents in the *ortho*- and *para*-positions of the phenolic ring, the formation of two isomers was observed. The two isomers are the *o*- and *p*-hydroxysulphonates.

The sulphonates isomerised and the melting points as well as the analyses of the sulphones obtained are recorded in Table I. In those cases where both *o*- and *p*-hydroxysulphonates are formed, they are shown as 'o' and 'p' respectively.

Details regarding the elucidation of the structures of the sulphones obtained will be published elsewhere.

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Annamalai V. BALIAH.

University,
Annamalainagar, August 20, 1953.

ON THE OCCURRENCE OF TWO SPECIES OF *XYLOTRECHUS* ON *CODIAEUM MACULATA*, A GARDEN CROTON

Xylotrechus smei Laporte le Gory and *Xylotrechus subscutellatus* Chevrolat have been found infesting *Codiaeum maculata*, a common garden croton, growing in the Coffee Research Station, Balehonnur.

From the emergence holes existing on the stem as well as from the general weak and unhealthy condition, it was suspected that the plant was infested with stem-borers and hence it was stumped and kept in a cage for observation during June 1953. Two beetles emerged on the 5th and the 6th of August. These were identified as *Xylotrechus smei* and *Xylotrechus subscutellatus*. Subsequent emergences were all of *X. smei*.

Xylotrechus smei has been recorded on 43 species¹ of host plants, but no mention is made of *Codiaeum maculata*. The beetle is 18 mm. long, brown with a greyish pubescence on head, prothorax, and forming spots on elytra. The colour of the markings are grey. There is an apical band; post-median, ante-median and humeral spots.

Xylotrechus subscutellatus has been reported to occur on seven plants, including *Coffea arabica*,¹ but no reference is made to *C. maculata*. The beetle is 17 mm. long, dark brown with a yellow pubescence on the head and prothorax and forming four bands on the elytra.

*X. smei*¹ and *X. subscutellatus*^{1,2} are mentioned as attacking mostly dying or felled trees. The presence of this croton plant in gardens on coffee estates may serve as an alternative host for this pest. The tunnels bored by both the species are packed with excreta and are

1. Fries, K. and Finck, G., *Ber.*, 1908, **41**, 4271.
2. Simons, J. H., Archer, S. and Randall, D. I., *J. Amer. Chem. Soc.*, 1940, **62**, 485. 3. Ger. Patent 532, 403; *Chem. Zentr.*, 1931, **102**, 3264. 4. Ger. Patent 555, 409, 9; *Chem. Zentr.*, 1932, **103**, 1692.

very similar to those of the coffee stem-borer, *Xylotrechus quadripes* Chev.

Our grateful thanks are due to Dr. M. Putta-rudriah for kindly identifying the insects, to Dr. H. Mari Gowda for kindly identifying the croton species, and to Dr. B. T. Narayanan and Mr. R. L. Narasimhaswamy for kind encouragement and helpful advice.

Coffee Res. Station, H. T. RANGA SETTY.
Balehonnur, H. HANUMANTHA RAO.
September 4, 1953.

1. Beeson and Bhatia, *Ind. For. Rec.*, 1939, 5, 1 (Entomology), 192-94; 199-200. 2. Subramaniam, T. V., "The Coffee Stem-Borer," *Ent. Series Bull., Dep. of Agr., Mysore*, 1941, 11.

SPOILAGE OF MACKERELS PRESERVED IN OIL

WHILE studying the preservation of mackerels in oil, we came across a type of spoilage similar to "sulfide stinker". Evolution of a stream of bubbles was noticed in less than 48 hours and within a week the fish disintegrated into a pulpy mass. Bacterial counts on sulfite agar were of the order of 10^6 . Twenty-one colonies were isolated and restreaked on Brewer's agar in Fildes jar and the pure colonies examined.

Morphological features showed that all of them were small motile rods, clavate, with terminal spores typical clostridia. The rods were single and in pairs with rounded ends. They all produced gas from cooked meat medium and Holman's medium and blackened the meat with partial digestion. Putrid smell was also noted but indole was not detected. Milk was coagulated but without 'stormy fermentation'. The bacteria belong to the genus *clostridium*, which is known to be the agent for the spoilage of canned foods.^{1,2} The source is suspected to be the guts of mackerels and further investigation on this is continuing.

Our thanks are due to the Director of Fisheries for permission to publish this note and to Sri. A. G. Vasavan for his assistance.

Fisheries Technological R. VENKATARAMAN.
Station, Kozhikode A. SREENIVASAN.
June 25, 1953.

1. Tanner, F. W., *Microbiology of Foods*, 2nd Ed., 1944, Garrard Press, Champaign, Illinois. 2. Jarvis, N. D., *Principles and Methods in the Canning of Fishery Products*, Research Report No. 7, Fish and Wildlife Service, Washington, D. C., 1943.

PRELIMINARY OBSERVATIONS ON THE BIOLOGY OF *CHIROCENTRUS* *DORAB* FORSK.*

THE flourishing dorab fishery along the coasts of Palk Bay and Gulf of Mannar in Ramnad District in South India is constituted chiefly of *Chirocentrus dorab*, probably the only clupeoid fish growing to a size of nearly 100 cm. In spite of its importance as a marine fishery resource, very little attention seems to have been paid towards a detailed study of this fish except for preliminary accounts on taxonomy by Hardenberg¹ and Deraniyagala,² general notes by Devanesan and Chidambaram³ and description of eggs and larvæ by Delsman.⁴ Owing to the occurrence of large shoals of dorab in the coastal as well as off-shore waters of Palk Bay and Gulf of Mannar, a detailed study of its biology was taken up at the suggestion of Dr. N. K. Panikkar, as part of the research programme of the Central Marine Fisheries Research Station.

The data collected from weekly samples of fish from fish landing places indicate that the dorab fishery is constituted of individuals ranging in size from 18-86 cm. Specimens in the larger size groups are caught in gill-nets whereas smaller as well as bigger ones are caught in shore-seines. Almost all the individuals landed from gill-nets are either in mature or post-mature stages and those caught in shore-seines possess immature as well as mature and post-mature gonads. An interesting peculiarity noticed in the commercial fish landings was that no male was observed in any of the size groups above 60 cm. Studies on size frequency distribution made for the past 18 months (from October 1951) have shown that the dorab fishery is constituted of individuals from 1-4 year classes. The average sizes attained by the first to fourth year class fishes were calculated to be 28, 44, 62 and 78 cm. respectively. Observations indicate that the first year class individuals ranging in size up to 22 cm. remain in the off-shore waters until the end of first year or the beginning of the second year of their life and that they do not make a significant contribution to the dorab fishery.

The results obtained from size frequency distribution studies were checked by a critical examination of the growth zones on the scales and otoliths of specimens in different year classes. In the scales of fishes ranging in size from 22-

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

86 cm., growth rings varying in number from one to four were observed and the average lengths of individuals were calculated to be 30.8, 42.03, 64.33 and 76.43 cm. Comparing these values with those arrived at from size frequency distribution studies, it could be seen that both the values are in good agreement. Similarly, the occurrence of identical growth rings ranging from one to four on otoliths also confirm the inferences made from the size frequency distribution and scale studies. Although it is rather difficult to ascribe special reasons for the formation of annuli in the scales and otoliths of these tropical fishes, it is probable that they are formed owing to the following reasons. In the immature specimens the change in environment from the deep and off-shore waters to the coastal waters may have some effect on the formation of annuli on the scales. In the mature fish the cessation of growth or the decrease in feeding activity soon after spawning (once a year) may well cause a drop in the rate of growth. These can, however, be established only on the basis of more intensive work. As this species is not a plankton feeder it is doubtful if the scarcity conditions of plankton are likely to cause growth checks to the same extent as in plankton feeders like the Malabar sardine.⁶ Similarly, the effects of the monsoon in this area being not so marked as on the Malabar coast, the growth rings observed here are also not likely to be caused by factors ascribed by Seshappa and Bhimachar⁷ to the monsoon-rings in the Malabar sole.

Regular examination of gonads of *C. dorab* from different size groups indicates that this species attains sexual maturity when about 50 cm. long, during the third year of life or at the completion of two years and that the mature individuals spawn during July-August. A statistical study of the measurements of the intra-ovarian eggs shows that spawning is restricted to a short and definite period, as the mature stock of ova are sharply differentiated from the immature. However, the spawning place of *C. dorab* which undoubtedly migrates away from the inshore area, is yet to be located.

Other aspects relating to the biology of *C. dorab* under investigation are the fecundity, rate of growth of gonads in relation to the growth of individuals, length-weight relationship in pre- and post-mature males and females, taxonomic and racial studies, development and seasonal variations, if any, on the food and feeding habits.

The author is grateful to Dr. N. K. Panikkar for guidance and encouragement.

Central Marine Fisheries M. S. PRABHU.
Research Station,
Mandapam Camp,
September 7, 1953.

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FIRST RECORD OF AN ICHTHYOBDELLAN LEECH BRANCHELLION SAVIGNY FROM THE INDIAN WATERS

Branchellion Sav. has been recorded from the Atlantic, the Mediterranean, and the Pacific, but not so far from any Indian sea.

A specimen of *Branchellion* collected by Mr. G. J. Phanuel from a fish market in Madras was kindly passed on to me for observation. The host is unknown. This is the largest specimen of *Branchellion* recorded so far, measuring 64 mm. in length. It resembles the type specimen of *Branchellion torpedenis* Sav. in most features but agrees with Moore's¹ specimen in having biannulation on the dorsal side of the abdomen. There are 33 pairs of branchiæ, and 11 pairs of pulsating vesicles, but in view of the highly lobed or frilled nature of the branchial edge not observed in any specimen recorded so far, a new specific name is suggested for it and is designated as *Branchellion plicusbranchus*.

This is the first record of the genus *Branchellion* Sav. from the Indian waters. A detailed account of this will be shortly published elsewhere.

My thanks are due to Mr. G. J. Phanuel for kindly placing the specimen at my disposal, and to Dr. J. P. Joshua for his valuable guidance in the study.

Dept. of Zoology, P. J. SANJEEVA RAJ.
Madras Christian College,
Tambaram, July 20, 1953.

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NEW HOSTS OF OROBANCHE

STIMULUS given by the report of wheat (N.P. 52) being attacked by Orobanche¹ led the author to examine the neighbouring fields having different rabi crops towards the end of last winter (February-March), when he came across 3 new hosts as given below:

| Host | | | Species of Orobanche |
|---------------------------------|---------------|------------------|-------------------------|
| Botanical name | Family | Local name | |
| <i>Euphorbia helioscopia</i> L. | Euphorbiaceæ | Dudhi | <i>O. cernua</i> |
| <i>Vicia sativa</i> L. | Leguminosæ | Chatrī Matri | <i>O. indica</i> |
| <i>Fumaria parviflora</i> Lam. | Papaveraceæ | Gajri | do |
| <i>Chenopodium album</i> L. | Chenopodiaceæ | Bathua | do |
| <i>Anagallis arvensis</i> L. | Primulaceæ | Krishna- neel | do |
| <i>Cnicus arvensis</i> Hoffn. | Compositæ | Katiya | do |
| <i>Leucas seylanica</i> R.Br. | Labiataæ | Guma | <i>O. cernua</i> |
| <i>Cyperus rotundus</i> L. | Cyperaceæ | Motha | <i>O. indica</i> |
| <i>Zea Mays</i> L. | Gramineæ | Maize | do |

Grateful thanks are due to Shri K. L. Khanna for affording facilities for the investigation and to Shri S. L. Sharma for his kind suggestions. Central Sugarcane Res. Station, D. RAO. Pusa (Bihar), May 26, 1953.

1. Sharma, S. L., *Curr. Sci.*, 1953, 22, 56.

A NOTE ON A HYBRID BETWEEN GRAIN-SORGHUM AND JOHNSON GRASS

VINALL⁴ reported two hybrids of cultivated sorghums with *Sorghum halepense* (Linn.) using Black Amber Sorgho as the pistil parent. Out of a number of varieties tried he could succeed only with Black Amber Sorgho while the reciprocal did not succeed. Next, Karper and Chisholm¹ reported a similar hybrid, using again sorghum as the stigma parent and they mention also certain natural hybrids grown by farmers in America under the name of Johnsongrass. Numerous trials were done in this Institute for hybridising Indian grain sorghums with *halepense* without success. Finally in 1952 two plants were obtained using *S. halepense* ($2n=40$) as the pistil parent and *S. durra* var. *Coimbatonicum* (Burkill) Snowden ($2n=20$) as the pollen parent (Fig. 1). Emasculation of the pistil parent was done by the bulk emasculation method of Stephens and Quinsby.³ The hybrid plants have $2n=30$ chromosomes as counted

in the root tip cells and are intermediate in their habit, leaf, panicle and spikelet size and shape. They are highly sterile. The plant characteristics agree with those described for the

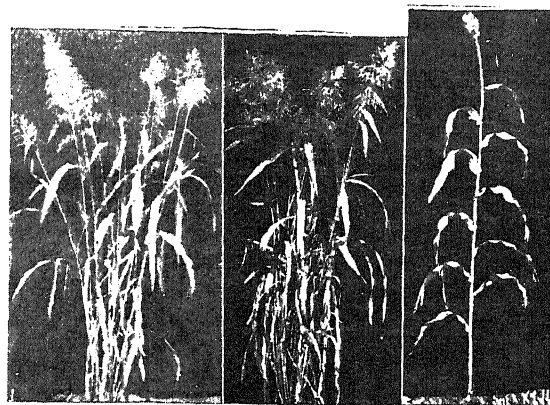


FIG. 1.—a. *S. halepense* (1/45 nat. size); b. F₁ (1/50 nat. size); c. *S. durra* var. *Coimbatonicum* (1/75 nat. size).

hybrids with Black Amber Sorgho obtained by Vinall.⁴ The plants are growing at the Millets Breeding Station, Coimbatore. The hybrid is of interest in that it is the first successful cross reciprocal in nature to that of the earlier workers and secondly a highly selected strain (Co. 1) belonging to a different group² has hybridised with it. A detailed report of the behaviour of these hybrids is being reported elsewhere. Our thanks are due to the Millets Specialist, Coimbatore, for the facilities given.

N. KRISHNASWAMY.

V. DURAIRAJ.

(MISS) M. S. THIANGAM.

Cytogenetics Laboratory,
Agri. Res. Inst.,
Coimbatore, July 2, 1953.

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ON THE MEGASPORE ARRANGEMENT IN PEUCEDANUM GRANDE CLARKE

Peucedanum grande Clarke belongs to the tribe Peucedanæ of the subfamily Apoidæ, in family Umbelliferae. It is an erect herb 3-4' in height with yellow flowers arranged in a compound umbel. It flowers during the later half of the monsoon. The material for the study was collected from Khandala, near Bombay, in

the month of August and was fixed in Navaschin's fluid with a prefixation in Carnoy's solution. Customary methods for dehydration and embedding were followed. The sections were cut out 10-12 μ thick and were stained in Heidenhain's Iron-alum-haematoxylin.

The inferior ovary is bilocular with a single functional ovule in each loculus of the ovary. The ovule is pendulous, anatropous, unitegmic and tenuinucellate.

In megasporogenesis generally the two meiotic divisions are normal and the four megaspores are arranged in a linear row. Usually the chalazal megaspore is functional while the three micropylar ones degenerate (Fig. 1). Sometimes the third megaspore from the micropylar end functions as an embryo-sac and the rest degenerate (Fig. 2).

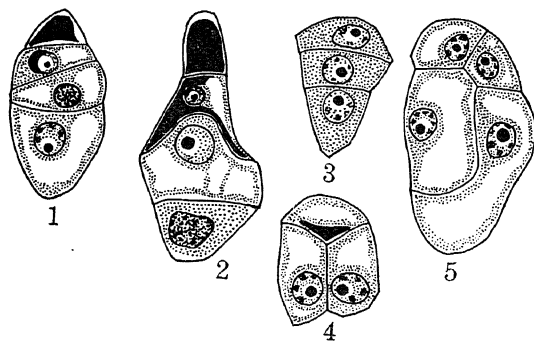


FIG. 1. A linear tetrad showing the degeneration of megaspores from the micropylar end, $\times 400$.

FIG. 2. The same, with the third megaspore from the micropylar end functioning, $\times 400$.

FIG. 3. Three megaspores arranged in a row, $\times 400$.

FIG. 4. Three megaspores arranged in the form of "1", $\times 400$.

FIG. 5. An isobilateral tetrad, $\times 400$.

Occasionally, 'three instead of four megaspores are formed, due to the suppression of the division in the micropylar dyad cell. These three megaspores may be arranged in a row (Fig. 3) or in the form of "1" (Fig. 4).

In rare cases, four cells are observed to lie isodiametrically (Fig. 5). These cells may be either a double dyad, derived from two megaspore mother-cells or an isobilateral tetrad produced from a single megaspore mother-cell. The latter is more probable, as the cells are highly vacuolated, a condition generally not found at a dyad stage. In this isobilateral tetrad, both the chalazal megaspores function as embryo-sacs (Fig. 5).

Fig. 4 shows a group of three megaspores where the chalazal dyad cell has divided vertically. If the micropylar dyad cell also divides by a similar vertical wall, an isobilateral tetrad is not an improbability.

According to Maheshwari¹ isobilateral arrangement is very rare and has been reported as an abnormality.

The author is grateful to Dr. T. S. Mahabale and Dr. R. D. Adatia for their valuable help during investigation and Rev. Fr. Santapau H. for helping in collecting the material from Khandala.

St. Xavier's College,
Bombay-1, July 16, 1953.

G. L. SHAH.

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AN INTERESTING ABNORMALITY SHOWING PHYLLODY AND PROLI- FERATION IN FLOWERS OF CASSIA SIAMEA

Two teratological flowers, somewhat comparable to the abnormal multicarpellary apocarpous pistil reported by Joshi¹ in *Poinciana regia* have been found in *Cassia siamea*. In these, in place of the monocarpellary pistil, is seen a short stalk ending in two open leaf-like structures. One of these looks like a small pinnately compound leaf, resembling a young leaf of the same plant (Fig. 1). The second one does not

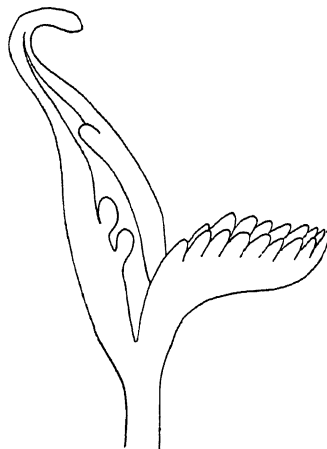


FIG. 1. Abnormal development in place of pistil in a flower of *Cassia siamea*.

bear a close resemblance to a pinnate leaf, but appears like a partly open carpel with a few ovule-like bodies on the margin. The tip is elongated into a stylar form. Serial sections were taken, and it was seen that what looked like ovules were not typical ovules but only parenchymatous enlargements supplied with a vascular bundle. There is no trace of any sporogenous cell or embryo-sac within them. Sections also indicate that the tip of the floral axis is not used up in the formation of the two leaf-

like parts, but is continued into a short residual portion being 1 or 2 minute rudimentary leaves.

Dept. of Botany, V. S. RAO.
R. R. College, (Miss) K. SIRDESHMUKH.
Matunga, Bombay-19,
June 6, 1953.

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THE MORPHOLOGY OF THE SCALES OF *DIGERA ARVENSIS* FORSK.

IN the flower of *Digera arvensis* (Amarantaceae) there are present two scales, each situated in the axil of a bracteole. The scale appears as a minute protuberance in the flower-bud and grows out into a green dichasium-like branched structure which together with its counterpart of the opposite side, encloses the fruit at maturity. The vascular supply of the scale is interesting. A trace appears in the axil of each bracteole and branches into three, a short distance up in the scale. The central branch ends blindly while the lateral two divide again into three branches all of which soon fade out in their respective organs (see Fig. 1).

Hooker¹ has considered each scale to be a reduced flower. Joshi and Rao² have confirmed this and conclude that the apparently single flower of *D. arvensis* is "a branch system, a ternate spikelet, bearing one perfect flower at the apex and two reduced flowers laterally". The vascular anatomy of the scale, however, suggests that probably it was originally an inflorescence or, to be more exact, a dichasium. In their present form, therefore, the different regions of the scale appear to represent only the axes of the original inflorescence whose flowers 'together with their bracteoles have disappeared. The apparently single flower of

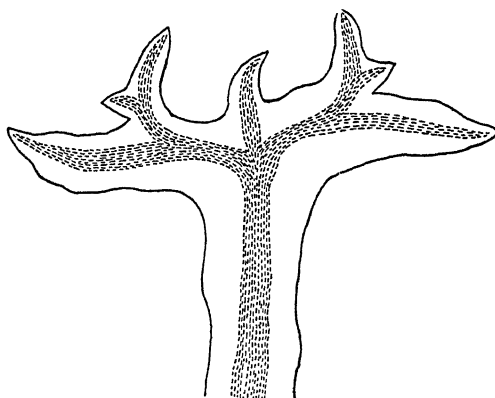


FIG. 1. Surface view of the scale of *Digera arvensis* showing its vascular supply.

the species thus seems to be a dichasium of which only the first flower has survived reduction and the two 'arms' have been reduced to just two scales. Could it be then that the family Amarantaceae has arisen from an ancient stock whose inflorescence consisted of a raceme of dichasia? Further work on a few more species of the family which the present authors³ have carried out appears to lend considerable support to this.

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and

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Birla College of Science,
Pilani, Rajasthan,
August 5, 1953.

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SCIENCE AND FREEDOM

THE International Congress of Science and Freedom held a meeting in Hamburg during July 23-26, which was attended by more than 100 delegates from nineteen countries, including fourteen from the United Kingdom. During the session, it was generally agreed that totalitarianism to-day constitutes the greatest and most potent threat to cultural freedom, and the infiltration of communist ideas into the circles of academic teachers and students has often given rise to a general distrust of the Universities as seed-beds of intellectual insubordination. This has led frequently to the demand that Universities should recognize without question existing economic and social systems in their respective countries.

The independent position of Universities has been further impaired by the fact that they have become increasingly dependent on government grants. These tend to foster those fields of science in which some practical or economic advantage is to be expected. In addition, the Second World War has resulted in the suppression or corruption of many of the older Universities of Europe, with their deeply rooted traditions of academic freedom. This has very seriously diminished the sense of cultural obligation among the public to support the progress of pure science, and it has become rare nowadays to hear the head of a University appealing for funds for the advancement of knowledge as an end in itself.

REVIEWS

Projective Geometry and Projective Metrics.

By H. Busemann and P. J. Kelly. (Academy Press, New York), 1953. Pp. viii + 332. Price \$ 6.0.

Here is a book written with a definite and unifying central theme, presenting Euclidean and hyperbolic geometries as special members of the family of projective metric spaces, viz., non-linear subsets of the projective plane, so metrised that "segments" exist (uniquely) connecting any two points and are contained in the projective straight line passing through these points (it follows that the topology induced by the metric is the ordinary topology).

The closed convex domains Γ with an affine centre O lead to the Minkowskian metrics $\Gamma(x, y)$. The distance $\Gamma(O, P)$ is the smallest positive number r such that $r\Gamma$ contains P . $\Gamma(x, y)$ is the distance of O from the point $x-y$. These are the only projective metrics on the entire affine plane for which the affine ratio of any three collinear points x, y, z is given by $\Gamma(x, y)/\Gamma(y, z)$. The Euclidean metrics are precisely those Minkowskian metrics where every straight line l allows of a distance-preserving "reflection" about it. This happens if and only if Γ is an ellipse. This characterisation is followed by the study of Euclidean motions and the theory of the conics in the Euclidean plane.

Again every closed convex domain Γ leads to a 'Hilbert' geometry—a projective metric space consisting of the interior of Γ . $\Gamma(x, y)$ is defined to be $\frac{K}{2c} \log(xy, pq)$ where the line xy cuts Γ in the points p, q . Hyperbolic geometry is the unique Hilbert geometry where every straight line l allows of a distance-preserving reflection about it. This again happens if and only if Γ is an ellipse. This characterisation is followed by a study of hyperbolic trigonometry and the motions allowed by the hyperbolic plane. The Caylean form of the metric associated with the non-definite form of Γ in hyperbolic geometry suggests the corresponding metric in the case of a positive-definite-form. This is elliptic geometry.

In the first three chapters the authors develop the necessary background of the projective and affine plane. The last chapter generalises the results to 3-spaces, drawing attention to such special features as Clifford parallelism.

There are a large number of examples and the book will serve as an excellent course of study in geometry at the Honours and Post-Graduate levels. It can be most heartily recommended for use by persons interested in geometry and as a very useful addition to our college libraries.

M. VENKATARAMAN.

Flames—Their Structure, Radiation and Temperature. By A. G. Gaydon. (Chapman & Hall), 1953. Pp. xii + 340. Price 55 sh.

Flame and combustion have proved a fertile field for research to chemists, physicists, engineers and physical chemists. The necessity of understanding the basic causes of explosion in mines prompted earlier chemists and physical chemists to undertake research on flame velocity, limits of inflammability and mechanism of explosions. The use of petrol in internal combustion engines presented the engineers with new problems, in particular, "knock", the solution of which appeared to depend on a better understanding of the phenomenon of combustion itself. With advances in the knowledge of molecular spectra, physicists were quick to apply the principles of molecular spectra to finding out the nature of emitting radicals in flames and combustion.

The author's approach to the study of flames and combustion is more from a physicist's point of view. The first three chapters are devoted to premixed flames. The problems in the category of these flames are: (1) the determination of flame velocity, (2) the shape and location of the burning zone, and (3) the stability limits of inflammability as governed by pressure and fuel air mixture. The present methods for the determination of flame velocity have been critically discussed. After this is presented a survey of our present knowledge of the mechanism of flame propagation with which is intimately connected the phenomenon of "knock" and its suppression.

In addition to premixed flames there is another important class of flames called the diffusion flames to which belongs the well-known candle flame. The process of heat transfer in industrial furnaces brings in the question of "carbon formation" which is also important for the efficiency of combustion in jet engines, since the presence of carbon

particles in gases entering the turbine blades may spell disaster. There is marked influence of turbulence on the efficiency of combustion, and this aspect has also been discussed.

The application of the principles of molecular spectra has yielded a wealth of information regarding the processes of combustion and the state of radiation from flames. The approach has been to determine vibrational, rotational and transitional temperatures and to compare them among themselves and also with theoretically calculated temperatures, and temperatures as determined by reversal methods. In some cases there is found to be no equilibrium between different energies—there is no equipartition of energy. Several chapters are devoted to the description and discussion of methods of the measurement of temperatures. These data also helps one to get an insight into the nature of radiation from flame as to whether it is thermal or chemiluminescent.

The volume contains several good plates, some of which are coloured, and there is an excellent index of references. The book will be of interest to the research workers who wish to be acquainted with the present state of knowledge regarding combustion and flames, more particularly from the angle of physicists. For those who are interested in the chemists' point of view, there are, of course, well-known treatises on combustion by Professor Jost and Von Elbe and Lewis.

W. M. VAIDYA.

Investigation of Rates and Mechanisms of Reactions—Technique of Organic Chemistry, Vol. VIII. By S. L. Friess and A. Weissberger. (Interscience Publishers Inc.), 1953. Pp. xxiii + 760. Price \$12.50.

Many chemists of standing and reputation from both sides of the Atlantic have made contributions to the volume under review, which deals with almost all aspects connected with the rates and mechanisms of reactions. The treatment is exhaustive both from the theoretical and the practical points of view. A preliminary survey on the general theory of rate processes, the comparison of collision and transition state theories, calculation of absolute rates, etc., is followed by three very useful chapters on (a) fundamental operations like control of environment, time, concentrations of reactants, etc., (b) experimental methods for determination of normal reaction, competing reactions, instantaneous reactions and reactions involving reactive intermediaries and free radicals, and (c) evaluation and interpretation of rate data.

The chapter on homogeneous gas phase reactions is concerned mainly with the techniques employed in the vapour phase reactions rather than with a review of the present state of kinetics of particular reactions, or types of reactions. Organic reactions such as decompositions, isomerizations and polymerizations have also been discussed.

The first part of the chapter on reactions in the liquid phase deals with the methods—stoichiometry, kinetics, transition state—to elucidate the mechanisms of the reactions. Methods for determining empirical formula and geometry of the transition state have been dealt with in an elegant manner. Specific experimental techniques are given covering (a) replacement reactions on aliphatic and aromatic carbon, (b) additions to carbonyl group, olefines, nitriles, cyanates, and isocyanates, (c) elimination reactions concerning carbonyls, olefins, carboxylic groups, (d) various rearrangement and isomerization reactions, and (e) redox systems. Homogeneous catalysis in solution, polymerization and polymer reactions have been treated quite exhaustively. Biological kinetics by manometry, spectrophotometry, polarography and chemical methods have been surveyed. Kinetics of enzymic reactions, enzyme-substrate compounds, catalases have all received a treatment very useful for the experimental and theoretical biochemist. The concluding chapter deals with the general principles of velocity measurement of rapid reactions in solution.

This judicious theoretical and practical treatment of reaction kinetics of varied types will provide very useful information to the organic, physical and biochemists. One of the interesting features of the treatment in this volume is that the research worker finds here all the essential experimental and theoretical tools ready at hand, as it were, for any new problem on any aspect of reaction kinetics.

M. SANTHAPPA.

Principles of Electronics. By H. Buckingham and E. M. Price. (Cleaver-Hume Press Ltd., London), 1953. Pp. 335. Price 15 sh.

The volume under review is one of the "Cleaver-Hume Electrical Series" edited by Prof. H. Cotton, and attempts to explain the general principles involved in the numerous applications of electronic devices in industry and engineering. At a time when specialization has proceeded so far that even in the narrow field of electrical engineering those who are

specializing in wireless communications, heavy currents engineering and electrical measuring and counting devices are fast becoming strangers to one another, a volume of this type giving a general survey of the whole field of electronic applications is a welcome addition. Naturally, one does not expect a volume of this size to give a detailed treatment of all the applications. But it would be found very useful to students following a general electrical engineering course, in providing them with a good grounding in the principles of the subject.

The first five chapters deal very briefly with the fundamental ideas underlying electronic phenomena, assuming the reader to have a general acquaintance with the theory of direct and alternating currents. The next seven chapters describe the principal electronic devices such as the vacuum tube, the thyatron, the photo cell, the cathode ray tube, the magnetron and the klystron, and give a brief account of their operation. The remaining six chapters explain some of the practical applications of these devices to industry and engineering. In the last section, special attention is given to the chapters on A.C./D.C. conversion and the applications of the photoelectric cell. The chapters on induction and dielectric heating, electric welding, electronic methods of controlling A.C./D.C. motors and electronic devices for registering and counting would be of great interest not only to students of electrical engineering but also to those following a general science course in our Universities who never really come to grips with the engineering applications of the science which they study only in theory.

In spite of the wide variety of the topics included in this little volume, the treatment is throughout simple and lucid, though necessarily brief. The descriptions and word pictures employed are fresh and illuminating. An attempt made in the early chapters to introduce the kilogram and the meter as units of mass and length is happily abandoned in the later chapters.

The book is profusely illustrated with neat diagrams. The printing and get-up are excellent. A useful index is included at the end. The volume is compact and comprehensive, and can be safely recommended to a wide range of technical and science classes of the University standard.

M. A. THANGARAJ.

Small Transformers and Inductors. By K. A. Macfadyen. (Chapman & Hall), 1953. Pp. xii + 237. Price 37 sh. 6 d.

The publication is a combination of theory, references for design and construction, appli-

cations and measuring methods of small transformers and inductors of various types: power transformers, wide-band transformers, instrument transformers, television scanning transformers, transformers and checks with magnetic polarization, inductors and transformers with high Q-factors, and pulse transformers.

The theoretical portion includes: (i) fundamentals of circuit theory, relating to 2-terminal and 4-terminal networks, (ii) an original phenomenological treatment of the magnetic circuit, introducing "complex permeabilities" for the representation of iron losses (without going into details about modern theory of magnetism), (iii) properties of the perfect transformer, effects of transformer imperfections and equivalent circuits for imperfect transformers.

General information about measurement and calculation of shunt and leakage inductances are collected in the chapter "Measurement, Calculation and Control of Inductances"; additional test methods, applicable for the above-mentioned special types of transformers are given in the succeeding chapters relating to the individual types.

Power transformer design is discussed both for 50 cycles and higher frequency transformers. Wide-band transformer data are limited to operation without D.C. polarization. Current and voltage instrument transformers and relating test methods are discussed together with television scanning transformers, due to similar requirements regarding phase errors for current transformers and scanning transformers. Gapped core choke design is explained, utilizing modern magnetic materials, and some fundamentals about gapped-core transformers, especially polarized audio-frequency output transformers. High Q-inductors for utilization in filters, tuned amplifiers, fluorescent lamp chokes, etc., are discussed under the heading of gapped-core inductors. An elementary theory and simple performance characteristics are given for pulse transformers, as utilized in radar techniques, pulse modulation in telecommunication systems and certain measuring methods; design data for power and voltage pulse transformers and their performance (pulse-form distortion) are discussed especially for rectangular pulses. A chapter about practical design and construction of transformers gives data about core materials, properties of British standard laminations, wire tables and methods of winding, screens, insulating materials, drying and impregnation of small transformers.

The book is a systematic introduction for the student or the unskilled engineer and physicist, rather than a reference book for the skilled

transformer designer. Perhaps it is necessary to point out that the author has not employed the rationalized MKS units in his derivations, but prefers a mixture of practical electrical and Gaussian magnetic units, in spite of its well-known dangers and inconveniences.

R. WALLAUSCHEK.

Chemical Analysis of Industrial Solvents. By Jacobs and Scheffan. (Interscience Publishers Inc.), 1953. Vol. VII. Pp. xxii + 502. Price \$10.00.

This volume is a welcome addition to the series of monographs on chemical analysis, inasmuch as it is the first of its kind to deal exclusively with the analysis of industrial solvents. The emergence of such a volume treating analysis of industrial solvents as a separate branch of chemical analysis is fully justified by the phenomenal development of the technology of solvents in the last few decades.

All the three phases of the subject—assay of any given solvent, analysis of mixtures of solvents and the identification of unknown solvents—receive systematic and exhaustive treatment in the several chapters of this book. Of the 14 chapters into which the book is divided, the first one is rightly devoted to methods of sampling, and the two succeeding chapters to a description of the physical and physico-chemical methods of solvent analysis. No effort has been spared to make these chapters as up-to-date as possible. The chapter on physiological effects of solvents, already dealt with in Vol. I of this series, could have been omitted from the present volume. But the chapter on the methods of determination of solvent vapours, though abstracted from Vol. I, is quite relevant and useful in this volume as well. Analysis of solvent mixtures forms the subject-matter of the next chapter in which are described standard methods such as the Goldman method, the I.G. method, etc., besides many elegant physico-chemical methods. Each of the remaining chapters gives specific tests for and methods of estimation of individual solvents classified according to their chemical similarity.

This informative, well-written and up-to-date volume is sure to find a place in the analytical section of every chemical and industrial library.

A. P. MADHAVAN NAIR.

Advances in Cancer Research, Vol. I. Edited by Jesse P. Greenstein and Alexander Had-dow (Academic Press), 1953. Price \$12.00.

In an age of outstanding discoveries in the field of medicine, certain diseases still elude

adequate comprehension and successful therapy. One of these diseases is cancer. In many parts of the world large funds from public and private sources are being expended for undertaking a successful solution of the problems associated with this disease. "A host of scientific specialities has been marshalled" to advance the knowledge, increase an understanding and probably control the occurrence of this disease in man. The results of this ceaseless quest and untiring search are reproduced in hundreds of publications in several languages in many countries. It is difficult, if not impossible, for an individual worker even in the speciality of cancer to keep track of all the advances in this one subject. The inauguration of an annual series of volumes, in which it is intended that research workers "in many lands, distinguished authorities in various branches of cancer research", would "review, synthesize and interpret the advances made in their individual areas of investigation" promises to supply a long-felt and important need. If the succeeding volumes maintain the same standard of excellence which is seen in the first volume, the editors, authors and publishers would deserve the gratitude of all persons who are engaged in cancer research.

The first volume comprises ten chapters by twelve authors, each chapter containing a comprehensive and critical review of recent work in one field of cancer research. The subjects covered are: Coulson, C. A.: "Electronic Configuration and Carcinogenesis"; Cowdry, E. V.: "Epidermal Carcinogenesis"; Dmochowski, L.: "The Milk Agent in the Origin of Mammary Tumours in Mice"; Gardner, W. U.: "Hormonal Aspects of Experimental Tumorigenesis"; Harris, R. J. C.: "Properties of the Agent of Rous No. 1 Sarcoma"; Heidelberger, Charles: "Applications of Radioisotopes to Studies of Carcinogenesis and Tumour Metabolism"; Miller, James A. and Miller Elizabeth, C.: "The Carcinogenic Aminoazobenzene Dyes"; Ross, W. C. J.: "The Chemistry of Cytotoxic Alkylating Agents"; Tannenbaum, A. and Silverstone, Hebert: "Nutrition in Relation to Cancer"; and Winzler, Richard J.: "Plasma Proteins in Cancer".

It is but natural that certain subjects should be more admirably reviewed than others: however, the general excellence of all the reviews is consistently maintained.

A word of criticism from a reviewer may not be out of place. The secretarial work should be definitely improved in future volumes. There are many typographical errors, and the checking up of references could be certainly better.

It may also be suggested that a uniform system of citing references would enhance their value.

V. R. KHANOLKAR.

Advances in Veterinary Science, Vol. I. Edited by C. A. Brandly and E. L. Jungherr. (Academic Press Inc., New York), 1953. Pp. xi + 431.

This is the first volume in a series, which reviews the progress in the more active fields of research related to veterinary science and veterinary public health. The advisory board for editing this series includes such names as Sir Thomas Dalling, P. J. Du Toit and others from different parts of the world. It is a collaborative work, in which comprehensive and critical contributions are made by twenty-one distinguished authorities on the subjects selected.

The reviews contained in this volume are: Animal Diseases and Human Welfare; Virus Diseases; Sulphonamides; Antibiotics; The Infertility Problem of Cattle; Bovine Mastitis; Swine Diseases; and Veterinary Public Health. Each topic is dealt with in detail under different aspects. They rightly emphasize the role of veterinary science in furthering human welfare, for "to-day the realization prevails that the health, vigour and prosperity of peoples and nations are largely dependent upon a healthy and productive animal industry. The impact on human welfare of the Anthrozooses—the diseases of animals transmissible to man and from man to animals—has been more clearly recognised through knowledge acquired during recent decades". These advances, described here, should, therefore, be of the greatest use to the serious student, the research worker, the practitioner, the public health authorities and human welfare workers.

Not only numerous diseases of public health importance are described under various aspects as diagnosis, controls, etc., but also their great economic significance. The advances made in virus diseases emphasize a better realization of the basic research approach to our knowledge of specific virus diseases. The sulphonamide and antibiotic therapies are described for numerous animal diseases. The infertility problem of cattle in all countries is of great importance on account of its huge economic loss. Veterinary Public Health, as both an old and new science, comprises all the community efforts influencing and influenced by the veterinary medical arts and sciences, applied to the prevention of diseases, protection of life and promotion of the well-being and efficiency of man. Recent advances in this field include not only re-

search in infectious diseases, cancer, pathology and zoo-techniques, but also participation in radiological health check ups, industrial hygiene, arctic disease research, graduate and international public health programmes, tackled by various organisations like WHO and the FAO.

The appendix contains the latest laws, amended upto February 1953, regarding Veterinary Public Health, in the United States. At the end of each review, a well classified and up-to-date list of references is given. The volume has every claim to a place among the well-known 'Advances' published in the other branches of science.

V. MAHADEVAN.

Soil Blocks. (John Innes Leaflet No. 12.) (Published by Oliver & Boyd Ltd. for the John Innes Horticultural Institution, Bayfordbury, Hertford, Herts), 1953. Pp. 7. Price 9d.

In this leaflet is discussed in some detail the technique of making and using 'Soil Blocks', a substitute for the traditional clay pots, for growing crops such as tomato, cucumber, lettuce, cauliflower and sweet peas. Soil blocks began to come into use in Britain about 5 years ago. In a dozen critical experiments recently carried out at Merton and Bayfordbury comparing large soil blocks with $3\frac{1}{2}$ " pots for the raising of tomatoes under a variety of conditions, and planting-out neither early nor late, the increase in weight of fruit picked in the first month was of the order $\frac{1}{4}$ lb. per plant. A scientific publication on the subject, which is stated to be in preparation, is awaited with interest.

S. C. P.

Books Received

The Manufacture of Compressed Yeasts. Second Edition. By F. G. Walter. (Chapman & Hall), 1953. Pp. x + 317. Price 37 sh. 6d. net.

Major Metabolic Fuels. (Brookhaven Symposia in Biology No. 5), (Associated Universities), 1952. Pp. vii + 233. Price \$1.35.

The Elements of Wave Mechanics and Quantum Mechanics. By K. R. Dixit. (Kitab Mahal, Allahabad), 1953. Pp. 149. Price Rs. 7-8-0.

Electrodeposition Research. (NBS Circular 529 of U.S. Dept. of Commerce), 1953. Pp. iv + 129. Price \$1.50.

Mechanism of Corticosteroid Action in Disease Processes. (Annals of the New York Academy of Sciences). Edited by Roy Waldo Miner. Vol. 56, Art 4. Pp. 623-814. Price \$3.50.

Tables for the Use of Geologists, Prospectors and Mining Engineers. By Prof. N. L. Sharma. (Indian Society of Engineers, Calcutta), 1953. Pp. ii + 30. Price Rs. 5.

SCIENCE NOTES AND NEWS

A New Host of *Alternaria tenuis* Nees.

Mr. N. C. Joshi, Department of Botany, Government College, Ajmer, writes as follows:

While working on the diseases of sugarcane the author observed a few spots on the leaves of *Cordia myxa* L. (Lashora) growing at the Govt. Sugarcane Research Farm, Shahjahanpur, in June 1952. It was found that the fungus isolated comes very near *Alternaria tenuis* Nees. (Elliot, J. A., *Am. J. Bot.*, 1917, 4, 439) because of the shape and size, fewer number of longitudinal septa and the range of the measurement of the length and breadth of spores. *Alternaria tenuis* Nees. has only been reported so far on *Saccharum officinarum* in India (Butler, E. J. and Bisley, G. R., *The Fungi of India*, I.A.R.I. Monograph No. 1, Oct. 1931) but this is the first record of the fungus on *Cordia myxa* L.

BHC Dust for Control of Sugarcane Stem-Borer

Mr. B. D. Gupta, Entomologist, Central Sugarcane Station, Lucknow, writes as follows:

During the years 1946-50 application of BHC dust in the furrows at the time of planting for warding off the termites was consistently observed to be beneficial in keeping down the stem-borer, *Chilo traea infuscatellus* (*Argyria sticticrasis* Hmps.) and root-borer, *Emmalocera depressella* infestation in sugarcane during May and June at the Main Sugarcane Research Station, Shahjahanpur. During 1950-51 and 1951-52, BHC dust was applied to the soil in a planted crop at the commencement of borer attack in May. The observations collected from the experiments confirmed its efficacy. The decrease in borer infestation was 55 and 71 per cent., respectively, against control during the two years. In the year 1952-53 the efficacy of the treatment was tested at the Central Sugarcane Research Station Farm at Bhadrak in Lucknow on fully replicated basis with four treatments, viz., 5, 10, 50 per cent. BHC dust and control. However, the quantity of BHC dust used in each case was 5 lb./acre. Figures on the whole failed to show the superiority of one treatment over the other, although the percentage of decrease against control depicted quite large variation ranging between 22 to 48 per cent. 5 per cent. dust recorded the lowest number of dead-hearts, 1363 per acre, against 2620 per acre in the control plots. Recently, similar results were obtained in the Punjab and Madras as well. It has also been

observed that low strength of the BHC at a high rate of application is more useful than one of high strength at a low rate. Further work is in progress at many research centres in the country and their results will be published in due course.

Improved Insecticidal Dusts

Although calcium carbonate has been considered by some to be incompatible with most organic insecticides because of its alkali content, mixtures of this mineral with DDT, EPN, gamma BHC, Heptachlor, Parathion, Toxaphene were still effective after storage for a year or longer in tests conducted by the agricultural stations in Texas and Mississippi. It was found that none of the insecticides broke down or lost their effectiveness when stored in tightly stoppered bottles at room temperatures. All except gamma BHC retained their effectiveness when placed in paper bags and stored at 100 per cent. relative humidity.

Several tons of toxaphene-calcium carbonate and another mixture containing gamma BHC, DDT and calcium carbonate, used in a field test after 6-8 months' storage, gave good control of boll weevil and bollworm. Boll weevil populations in two cotton fields where the experimental dusts were used decreased in 14 days from 60 per cent. infestation in each field to 25 and 28.5 per cent.

A New Dense Crystalline Silica

In an article under the above title occurring in *Science* (1953, 118, 131), L. Coes Jr. has reported the preparation of a new modification of SiO_2 by heating dry sodium metasilicate and diammonium phosphate to 750°C . under a pressure of 35,000 atmospheres for a period of 15 hours. The material could also be obtained with other mineralising agents and also by oxidising silicon by silver carbonate.

The dense silica is obtained as colourless tabular hexagonal crystals of density 3.01. Chemically, it is very inert and is scarcely affected by hydrofluoric acid. The crystals are stated to belong probably to the triclinic system. They are optically biaxial (+ve) with an optic axial angle of 54° . The refractive indices are $n = 1.599$, $\gamma = 1.604$. Its hardness approaches that of spinel.

The dense silica is stable at ordinary temperatures and pressures, but it is not formed below 35,000 atmospheres. The results are

believed to be of great importance in the study of the condition of crystallisation of rock minerals. Its absence in various rocks provides a maximum pressure above which they could not have been formed.

Study of Human Blood Groups

The study of human blood groups and their clinical effects have gained considerable importance lately. Discovery of new blood groups is making this study more complicated and a reference laboratory in this country has been a long-felt necessity. It has been found that a lot of material is being wasted for want of facilities for detailed investigation. The Human Variation Unit of the Indian Cancer Research Centre is now in a position to undertake reference work in all known blood groups through the kind co-operation of the reference laboratories in U.K. and U.S.A. Officers-in-charge of various blood transfusion units and maternity centres are requested to send to this unit any interesting specimen they may come across. Serum and clotted blood may be sent in sterile containers to Dr. L. D. Sanghvi, Indian Cancer Research Centre, Parel, Bombay.

Biological Synthesis of Vitamin C

An important advance in our knowledge of how plants make vitamin C has recently been achieved at Cambridge by Mapson and his colleagues (*Nature*, 1953, 171, 348). According to Isherwood, Chen and Mapson the steps along the route of synthesis in the plant or animal are D-glucose, D-glucurono- γ -lactone, L-gulonon- γ -lactone, and L-ascorbic acid. With galactose the corresponding steps are D-galactose, D-galacturonic acid, L-galactono- γ -lactone, and L-ascorbic acid. A fundamental feature of the scheme is the change at the second step, from the D- to the L-series with inversion of the whole molecule. This has in fact been verified by using radioactive labels. L-galactono- γ -lactone is more efficient than L-gulonon- γ -lactone in promoting the synthesis of ascorbic acid in plants, but both are equally effective in animals.

Control Laboratory for Leather Analysis

The Governing Body of the Council of Scientific and Industrial Research have approved the setting up of a Control Laboratory at the Central Leather Research Institute, Madras, for the analysis of East India (E. I.) tanned leather. The Control Laboratory is to be financed by the Agricultural Marketing Adviser to the Government of India, Ministry of Food and Agri-

culture and will be under the administrative control of the Director, CLRI, Madras.

Specialized Bibliographic Services in Chemistry, Medicine and Psychology

The literature-searching facilities of *Research Information Service* of New York City, so far reserved for a few select clients, are now at the disposal of all organizations and individuals engaged in research and promotion activities in the field of science and industry, particularly those pertaining to all branches of applied and theoretical chemistry, medicine and psycho-analytical science. Inquiries directed to RIS should be as specific as possible regarding the exact nature of the topic in question, the type of literature desired, the countries to be included in the search, and the period of time to be covered. Correspondence should be addressed to Bibliographic Research Department, Research Information Service, 53, Nassau Street, New York 38, N.Y.

Supply of Research Chemicals

Arrangements for the preparation and supply of the following chemicals at reasonable rates have been made at the National Chemical Laboratory of India, Poona: acetyl phenylhydrazine, benzoic acid, diphenyl ketene, glycerol mono-chlorohydrin, 8-hydroxy quinaldine, 8-hydroxy-quinoline, *p*-nitrosobenzeneazo- α -naphthol, *N*-phenyl anthranilic acid and trichloroacetic acid. Heads of scientific and research institutes are invited to communicate their requirements to the Director, NCL, Poona-8.

Award of Research Degree

The University of Poona has awarded the Ph.D. Degree in Botany to Mr. S. Govindaswami for his thesis entitled "Cytogenetical Studies in the Genus *Musa*".

The Andhra University has awarded the D.Sc. Degree in Physics to Mr. Y. V. Somayajulu for his thesis entitled "Studies in Fading of Continuous Wave Radio Signals with the Aid of Simultaneous Pulse Observations and Theoretical Study of Oblique Propagation in Equatorial Regions".

The Geological, Mining and Metallurgical Society of India

Office-bearers for 1953-54: *President*: Mr. M. K. Ray; *Vice-Presidents*: Mr. S. C. Ghosh and Dr. C. Mahadevan; *Joint Secretaries*: Prof. N. N. Chatterjee and Prof. N. L. Sharma; *Treasurer*: Prof. P. C. Dutt.

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TOWARDS ADEQUACY OF SCIENTIFIC AND TECHNICAL MANPOWER

IN the present context of inadequate supply of scientific and technical manpower in our country, the recommendations* of the National Manpower Council of the U.S.A. will be read with wide interest. In the course of its report, the Council observes, "Nothing short of a determined co-operative effort involving government, industry, educational institutions and professional and other groups will attain this goal."

Such a co-operative effort, supported by informed public opinion, is to be achieved in regard to the following objectives: development of more reliable knowledge about our human resources; strengthening of the institutions which train scientists and professionals; maintenance of a continuous flow of students through colleges and universities; increased opportunities for capable young persons to secure higher education; and better utilisation

of the available supply of scientific and professional personnel.

In regard to the first objective, the Council recommends that foundations and universities encourage and support research designed to increase our understanding of educational and career choice processes, of the factors facilitating the development of talent and intellectual ability, and of the conditions contributing to superior performance; that private and governmental agencies concerned with the development and utilization of scientific and professional manpower intensify their efforts to collect and analyse significant information about these critical resources; and that the Federal Government, because of its specific responsibilities and unique facilities, institute suitable guidance in the matter.

By way of strengthening the institutions which educate and train our scientists and professionals, the Council recommends: (1) that state and local governments, alumni, business, labour, and other interested groups and individuals intensify efforts to provide the financial

* *A Policy for Scientific and Professional Manpower.* Prepared by the Research Staff of the National Manpower Council, New York. Columbia University Press, 1953.

support required for the improvement of faculties and facilities; (2) that the President appoint a Commission composed of Government, university and industrial representatives to review the impact of governmental research and development contracts upon the primary responsibilities of universities and colleges to advance fundamental knowledge and train the scholars and scientists of the future; and (3) that institutions of higher education recognise that a dynamic society requires the kind of education and training that equips students to meet not only the demands of their first jobs but also the challenges of new tasks and problems which they will face years later.

To help maintain a continuous flow of students in colleges and universities, it is recommended that the public continue to support the present student deferment programme and that the sufficient flexibility be exercised in the matter of calling to active duty of students enrolled in ROTC programmes so that well qualified students are permitted to pursue graduate work prior to their military service.

In regard to the provision of greater opportunities for young people for higher education, the Council requires that the public and elected officials fulfil their responsibility to maintain good elementary and secondary schools by providing the financial and personnel resources needed to remedy present weaknesses in the educational system; that schools, professional societies, governmental agencies, and other interested groups act together to strengthen high school and college information and counselling services to insure sound organisation of schools, courses and careers; and that scholarship and fellowship programmes supported by private and public funds be maintained and expanded to help more young people of ability to acquire a higher education.

Towards the last objective, *viz.*, better utilisation of available scientific and professional personnel, the recommendations of the Council are: (1) that the President initiate a review of legislation and administrative procedures governing the recall of reservists to active duty in order to develop a system of providing civilian participation in determining the distribution of scientific and professional personnel required to meet civilian and military needs; (2) that management intensify its efforts to determine the most effective balance among the different types of manpower it employs in order to insure efficient and economical operations and to provide for the further training of the manpower for which it is responsible; and (3) that business and Government intensify their efforts to

develop executives who understand the importance of insuring that each highly trained employee has the opportunity to utilize his capacities as fully as possible.

Considering that the provision of right channels of training in science and technology go a long way in solving the problem of adequate national manpower, reference may also be made here to the valuable suggestions of Sir Richard Southwell on the subject, in the course of his Trueman Wood Lecture this year.†

Sir Richard holds that in every country the structure of technological education is (and should be) conditioned by the structure of its industry, and that this in turn is conditioned by its history and will not be understood except through study of it. Naturally, in planning the educational structure of a country, one must have regard to the structure of its industries. Proposals which would merely copy other nations without enquiry as to why their practice is different, defeat themselves. As he says, "If it is better designed to meet like needs, then let us copy it by all means; but let us be certain, first, that the needs it meets are not also different."

In regard to the role which the universities can play in a national plan for training in technology, Sir Richard's views are very interesting. The universities are to be, in his opinion, the GHQ of the 'science which is pursued with a view to application', but *not*, be it noted, as having direct concern with applications. The teaching at undergraduate level should aim to instil a knowledge only of basic principles, and develop the power to grasp the essentials of a problem. Like medical schools they are to train men not to practise but to learn; to learn an art which calls for more than technical erudition.

The universities will also train at the post-graduate level: not only (as in the past) by supervised research of the kind that results in theses, but also (what a few have started already) by courses in the harder and newer parts of applicable science. To this end their teachers will keep close contact with the mono-technics and, through them, with industry; both as advisers and by visits in which they will learn of new industrial problems. Being the GHQ, the 'headquarters troops' must be mobile enough, if the larger ends of scientific and technical manpower are to be served adequately.

† *Training for Science and Technology*. The Trueman Wood Lecture by Sir Richard Southwell, F.R.S. *Jour. Roy. Soc. Arts*, 1953, 51, 794.

NOBEL AWARD FOR PHYSICS, 1953

THE NOBEL PRIZE FOR PHYSICS this year has been awarded to Professor Fritz Zernike of Groningen University, Holland, for his invention of the phase contrast microscope. Professor Zernike is now aged 65. He took his Doctorate Degree at the University of Groningen in 1915 and has continued to work in the same institution ever since.

Professor Zernike has made significant contributions to wave optics and diffraction theory, both in the field of optics and x-rays. The celebrated Zernike-Prins formula for the diffraction of x-rays opened a new line of investigation for understanding the structure of liquids. Ideas of phase contrast were put forward and discussed by Zernike in several papers even in the 1930's, but it was mainly in the post-war period that it has been widely applied in microscopy.

It is true to say that progress in a vast field of biology has been held up owing to the lack of a satisfactory method of observing the structure of living cells. In ordinary methods of microscopy, these could be studied only by fixing and staining the required structures. This is so, because a living cell is a highly transparent object and no differentiation between

the different structures would be observable unless they are preferentially stained. Nevertheless the cell is composed of regions of different refractive indices, so that they offer varying optical paths to a beam of light going through it, and thus produce varying phase changes in the different regions of the transmitted beam. In the phase contrast microscope, these changes in phase are converted into variations of intensity, by introducing an optical device known as a "phase plate", into an ordinary microscope. The thicker regions would appear darker, thus producing the necessary contrast in the appearance of the cell. Indeed, we might regard the effect of phase contrast illumination as similar to a (hypothetical) dye which is stained at every point of the object with an intensity proportional to its thickness.

The phase contrast microscope has proved to be invaluable in the study of living cells in their natural state. The biologist who studies such materials can now be reasonably confident that the image he sees gives something approaching a true picture of what is actually present. The importance of phase contrast microscopy to biological research cannot therefore be overestimated.

NOBEL AWARD FOR CHEMISTRY, 1953

THE NOBEL PRIZE FOR CHEMISTRY has been awarded this year to Professor Hermann Staudinger of Freiburg University, West Germany, for his classical investigations in high polymer chemistry extending over three decades.

Professor Staudinger started his researches about 1915 with naturally occurring complex organic substances like cellulose, rubber, etc., whose behaviour was puzzling to the early orthodox organic chemists, who consequently discarded these substances from their range of investigations. Staudinger has held the view right from the beginning that structural theories of organic chemistry are quite adequate to deal with these complex organic molecules. In fact, he brought order into the so-called 'anomalies' of complex organic molecules, to which he gave the name 'macro-molecules', and therefore he can be aptly described as the father of modern high polymer chemistry. His researches have however found the greatest appreciation only in the past few years, because of the tremendous value they have lent to the industrial high polymers, viz., plastics.

Professor Staudinger's researches were concerned with cellulose, rubber, fibroin, polyoxymethylenes and ethylenes, polyindenes and polyvinyl compounds, notably polystyrene and polyacrylic esters. These investigations, quite apart from their utilitarian aspect to plastics industry, have given a great insight into various fundamental aspects of the phenomenon of polymerization itself. In fact, models of these synthetic polymers are highly useful in explaining the structure and properties of natural polymers. The Staudinger relation between the viscosity and molecular weight of a macromolecule in its various modified forms has been an invaluable tool in the hands of high polymer chemists all the world over. Staudinger has also tried to explain the physical properties of high polymers such as their elastic, rubbery, viscous, resinous and thermohardening behaviours, as well as their technical properties like toughness and tensile strength on the basis of the nature, configuration and interaction of the units in the long chain macromolecule.

Professor Staudinger has had a wide influence in building new schools of research in high

polymer chemistry, initially in Switzerland and later in Germany. He was for sometime Head of the Department at the Karlsruhe Chemical Institute, and afterwards at the Technical High School, Zurich. Later he was appointed to the Chair of Organic Chemistry in the University of Freiburg.

Professor Staudinger has also evinced great interest in the practical applications of his investigations and therefore has come to play no small role in the development of the plastics industry in Germany.

M. SANTAPPA.

ARCHITECTURE OF TECHNOLOGY AT THE MELLON INSTITUTE, U.S.A.

JUST as applied science relies on pure science, so does technology depend upon applied science, as is shown comprehensively in the current investigational programme of the Mellon Institute contained in their annual report, No. 40, for 1952-53.

Forty-five years have passed since the Institute's Non-Profit Fellowship System originated by Robert Kennedy Duncan (1868-1914) was put into operation in alliance with University education and research. The fellowship system has clearly demonstrated that societally valuable results and professionally important gains could be expected from thoroughly directed long-range scientific research. The Mellon Institute was founded at Pittsburg, Pennsylvania in 1913, by Andrew W. Mellon (1855-1937) and Richard B. Mellon (1858-1933). The accomplishments of the fellowships since their foundation have had the cumulative effect of bringing many more proposals and much more support for research, and of inducing the provision of special scientific services to the whole research staff. The Institute has proved that it can generate achievements welcomed as useful to humanity. Its administrative principles have cut down the lag between scientific discovery and its practical application. Since 1907, there have been a total of 438 fellowships of which 363 have concluded their researches. The average tenure of these fellowships was $4\frac{1}{4}$ years. The remaining 75 fellowships now at work, have an average of $12\frac{1}{3}$ years.

Among the sciences predominating in the Institute's activities, chemistry, physics and biology are joined securely by many connecting links. It is recognised that there can be no boundaries between the sciences in the search for needed knowledge and a number of these sciences can well have joint efforts of advantage in wide investigational programmes.

Multiple fellowships of the Institute often have specialists in several sciences.

The Institute has never been so pre-occupied with applied science that it has not devoted much attention to pure science. It maintains a well delineated continuing series of basic researches, which have demonstrated the advantageous broadening and strengthening of the Institute's functions in pursuing a many-sided attack on major problems of science and technology.

Scientific enquiry of chiefly or entirely a theoretical nature often results as a bypath of applied research. This architecture of technology has yielded 2,429 contributions to the literature of science since 1910. In the fiscal year 1952-53 the Institute's expenditures for pure and applied researches amounted to 2 crores of rupees. Of this sum, 40 lakhs were spent in supporting creative investigations in pure science. 116 members of this Institute have been engaged in pure science research, while 279 fellows and 221 aids have been working on the industrial fellowships. The Institute has also a loyal and capable servicing staff of 216.

The constitution of the Institute's departments and fellowships is clearly defined and the careful selection of the members assures good syntality (group personality) as well as requisite scholarship and resourcefulness. There are many incentives for continuous all-out investigational effort.

A prominent feature of the Institute is that its fellowships, while they keep within their defined purposes, do not work in isolation. The spirit and habit of collaboration stressed in the Institute add constantly and considerably to the vigour, harmony and unity of its work. This cherished team-work conduces to close professional and social association, and promotes cohesiveness.

M. A. GOVINDA RAU.

IN VITRO SYNTHESIS OF CITROVORUM FACTOR ACTIVITY
BY RAT BLOOD

V. B. MITBANDER AND A. SREENIVASAN

Department of Chemical Technology, University of Bombay, Bombay

THE recognition of a new factor in liver¹ and in fermentation liquors² which supports the growth of *Leuconostoc citrovorum* 8081 and its close relation to pteroyl glutamic acid (PGA)^{3,4} has been followed by its synthesis (folinic acid,⁵ leucovorin⁶) from PGA and isolation from liver in a crystalline form.⁷ Excretion of this factor (CF) in urine is in proportion to the amount of PGA in the diet.⁸ CF concentrates and leucovorin are more effective than PGA in reversing antagonists of PGA for micro-organisms and mice;⁴ natural CF in this respect is nearly twice as active as the synthetic product.⁷ Leucovorin is also much more active than PGA in inducing the disappearance of megaloblasts in cultures of bone marrow of untreated patients with pernicious anemia.⁹ These findings along with observations on the enzyme systems present in rat liver¹⁰ and in *Lactobacilli*¹¹ converting PGA to CF would indicate that CF or a derived product from it is the functional form of PGA.

The ability of blood cells to convert riboflavin to flavinadenine dinucleotide,¹² nicotinic acid to nicotinamide mononucleotide¹³ and thiamine to co-carboxylase¹⁴ suggested this search for the presence of a similar mechanism in blood for the conversion of PGA to CF activity.

Adult albino rats (inbred Wister strain) were maintained on the laboratory stock diet or in the case of folic acid-deficient rats, on the purified folic acid-free ration of Fatterpaker *et al.*,¹⁵ with supplementation of 0.15 mg. per kg. of vitamin B₁₂ (Merck) and 2 per cent. phthalylsulphathiazole. The blood,

withdrawn under phenobarbitone anesthesia from the portal vein was collected into chilled, citrated Erlenmeyer flasks and quickly utilized for the experiments.

The procedure followed for the *in vitro* synthesis of CF consisted in incubating at 37° C. a mixture of 2 c.c. blood and 2 c.c. Krebs-Ringers phosphate buffer of pH 7.4, together with appropriate additions (Table I) and water to a total volume of 5 c.c. At the end of 3 hours, the contents in each vessel, after adjustment to neutral pH, were autoclaved for 15 minutes at 15 lb. pressure, cooled, homogenised and centrifuged. The supernatants which were often turbid were assayed titrimetrically¹⁶ for CF activity using *L. citrovorum* 8081 as the test organism and leucovorin (Lederle) as the standard. The cells in duplicate sets of flasks were crushed well after incubation and pH brought to 7.6. The contents were next autolysed under toluene for 24 hours at 37° C. prior to assay after neutralization and autoclaving as above. Under these conditions there was maximum release of bound CF which accounted for most of the CF activity. Enzymic release of bound CF²³ was not resorted to on account of the high blanks.

From the results presented in Table I, it may be observed that the blood system could convert PGA to CF. This synthetic ability is destroyed if the blood were heated at 100° C. for 3 minutes. The values with the autolysed samples suggested that the enzymes for this conversion resided in the cells and was confirmed in other experiments with the formed

TABLE I

Synthesis of CF activity from PGA by normal and PGA-deficient rat blood

| Supplements | Normal animals | | PGA-deficient animals |
|-------------------------------------|------------------|-----------------|-----------------------|
| | Before autolysis | After autolysis | After autolysis |
| CF μ g. per c.c. blood | | | |
| Blood | 0.20 | 4.92 | <0.2 |
| Blood+PGA (10 μ g.) | 1.72 | 8.90 | 9.0 |
| Blood+PGA (10 μ g.)+AA*(10 mg.) | 3.20 | 13.72 | 13.0 |

* Freshly neutralised ascorbic acid (AA)

elements of the blood only. The effect of ascorbic acid in enhancing CF synthesis is appreciable as with liver slices.¹⁰

Maximum synthesis with intact cells occurred in 3 hours of incubation and, under comparable conditions crushed cells did not show much synthetic ability for CF. These observations excluded the possibility of any synthesis occurring during autolysis, the increased values for CF being therefore, attributable to liberation from bound forms only.

The results with blood from PGA-deficient animals, included in Table I, would show that though there is negligible CF activity present initially, incubation with PGA with or without AA produces nearly as much CF as with normal blood. However, there is evidence to suggest that in a folic acid deficiency induced by aminopterin there is almost complete impairment of this enzyme system.

Aminopterin addition to the incubating mixture (Table II) blocks the conversion of PGA to CF by the blood cells considerably (cf. 17); for these experiments, the standard curves were run in presence of aminopterin and it was ascertained that, in the dilutions employed, it made no difference from normal in the response to growth by the organism. Since aminopterin is also known to interfere with the utilization of CF in micro-organisms,^{3,18} it would seem that this antagonist may have two or more important sites of action and interference with the metabolic alteration of PGA is only one of them.

TABLE II

Effect of aminopterin on in vitro synthesis of CF from PGA by normal rat blood

| Supplements | CF $\mu\text{g.}$ per c.c. blood |
|-------------------------------------------------------------------------------|----------------------------------|
| Blood | .. 5.0 |
| Blood+FA (10 $\mu\text{g.}$) | .. 9.4 |
| Blood+FA (10 $\mu\text{g.}$)+Aminopterin (5 $\mu\text{g.}$) | .. 4.8 |
| Blood+FA (10 $\mu\text{g.}$)+AA (10 mg.) | .. 14.2 |
| Blood+FA (10 $\mu\text{g.}$)+AA (10 mg.) +aminopterin (5 $\mu\text{g.}$) | 6.2 |

In an attempt to characterize the CF activity synthesized by the blood cells, a dose response curve was obtained for *L. citrovorum* against increasing concentrations of the blood filtrate and was found to differ from a similar curve with equivalent concentrations of Leucovorin (Fig. 1). Such a difference was also seen with the xanthine culture filtrate of *L. arabinosus* which synthesizes considerable CF activity from p-aminobenzoic acid¹⁹ and has recently been

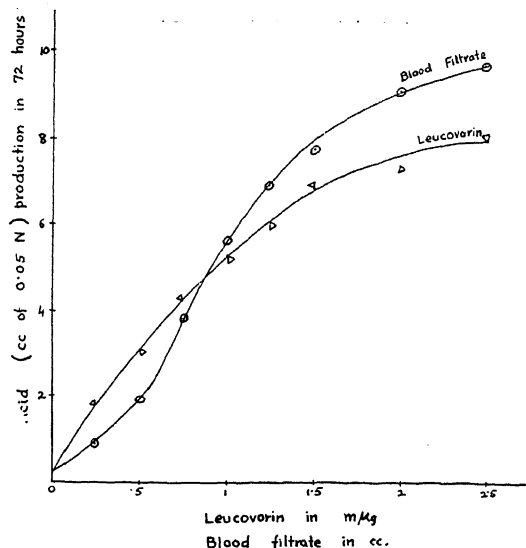


FIG. 1. Dose Response Curve

reported for Hemofolin,²⁰ a factor synthesized when leucocytes from bone marrow are incubated with PGA. While there are reports of probable new factors^{21,22} and conjugates²³ related to CF, it is possible that presence of inhibitors or activators in blood filtrates and other crude extracts may account for the observed differential response. Bioautographic studies to characterize the CF activity are in progress.

Our thanks are due to the Indian Council of Medical Research for supporting this work and to Lederle Laboratories, Ltd. and Chas. Pfizer, Inc., for generous supplies of chemicals.

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NATIONAL RESEARCH COUNCIL OF CANADA—POST-DOCTORATE FELLOWSHIPS

THE NATIONAL RESEARCH COUNCIL OF CANADA will award for 1954-55 approximately 40 Post-Doctorate Fellowships for research in chemistry and physics, tenable in the National Research Council Laboratories at Ottawa, and 10 Post-Doctorate Fellowships in the biological sciences, tenable in the Prairie Regional Laboratory of the National Research Council at the University of Saskatchewan, Saskatoon, and in the laboratories at Ottawa.

Chemistry: (approximately 25 awards, tenable in the Ottawa Laboratories).—Chemical Kinetics and Photochemistry; Surface Chemistry and Low Temperature Colorimetry; Molecular Spectra; Organic Chemistry with Special Reference to Alkaloids and Other Natural Products; Mechanism of Organic Reactions; Absorption Spectra of Organic Compounds; Physical Properties of Liquids and Gases; Critical Temperature Phenomena and Liquid Structure; Catalysis; Colloids; Corrosion Research; Chemical Engineering; Metallurgical Chemistry; Polymer Chemistry.

Physics: (approximately 15 awards, tenable in the Ottawa Laboratories).—Molecular Spectra; Molecular Beams; Cosmic Rays; X-Ray Diffraction; Low Temperature and Solid State Physics; Theoretical Physics; Acoustics; Photographic Optics; Photogrammetric Research; Atmospheric Optics; Radiology.

Biological Sciences: (approximately 10 awards, tenable in the Saskatoon and Ottawa Laboratories).—Microbiology; Fermentation Chemistry and Enzymology; Carbohydrate Chemistry; Biosynthesis of Lignin; Chemistry

of Vegetable Oils and Fats; Enzymatic Studies of Proteins; Photosynthesis; Biometrics; Animal Biochemistry.

An applicant should not be more than 35 years of age and should possess a Ph.D. Degree from a recognised University or expect to obtain such a Degree before taking up this award. There are no restrictions as to the nationality of the applicant, but successful applicants must meet all Canadian immigration requirements. For single Fellows the stipend is \$3,000 per annum, and for male Fellows who are married, the stipend is \$3,500 per annum. This award is tax-free and payments are made twice monthly. A grant-in-aid of travelling expenses will be made to persons coming from abroad. A further grant will be paid to a married Fellow if his wife accompanies him to Canada. A similar grant will be made on the termination of the Fellowship if the holder is returning to his home abroad. Fellowships are tenable for a period of one year, but applications for a renewal for a second year will be considered.

Applications shall be made on a special form that may be secured from the Secretary, Laboratories Awards Committee, National Research Council, Ottawa, Canada, or from the Chief Scientific Liaison Officer, National Research Council of Canada, Africa House, Kingsway, London, W.C.2, England, and should be submitted direct to the Ottawa address, not later than February 15, 1954. For additional information regarding these Fellowships, attention is directed to a booklet entitled "National Research Council Post-Doctorate Fellowships".

INSTITUTE OF PHYSICS (INDIAN SECTION), LONDON

As the result of a recent postal ballot, the Committee of the Indian Section of the Institute of Physics, London, has been reconstituted as follows: Sir C. V. Raman (*Chairman*), Dr. S. S.

Bhatnagar, Dr. K. S. Krishnan, Prof. G. I. Finch, Dr. S. Ramachandra Rao and Mr. T. N. Seshadri (*Hon. Secretary*).

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A PARADOX RELATED TO POISSON'S
EQUATION

LET us consider the whole space filled with matter of uniform density, ρ ($\rho \neq 0$) say. Then from symmetry there is no gravitational field of force because the attraction of any element is counteracted by that of another element situated at the opposite direction but at equal distance. Therefore we get the gravitational potential $\phi = \text{const.}$

Now by Poisson's equation

$$\nabla^2 \phi = 4\pi\rho$$

If we put $\phi = \text{const.}$ in the equation,

we get

$$4\pi\rho = 0$$

which contradicts the hypothesis $\rho \neq 0$.

The explanation of this paradox is to be looked for in the meaning of the statement: 'whole space filled with matter'. This may be

looked upon as a body of large dimension (e.g. a sphere of radius R) and of uniform density (ρ) and then considering that the dimension increases without limit ($R \rightarrow \infty$). Looked at this way, the argument using symmetry stated above will fail because any point of a large sphere (except the centre) is not symmetrically situated with respect to the sphere and forces on all sides will not balance one another.

This solution of the paradox however does not appear to us satisfactory. The whole difficulty is over the meaning of the phrase 'the whole space filled with matter of uniform density ρ ', the meaning of which to us is $\rho(x, y, z) = \text{const.}$ (for all values of x, y, z) and not as follows: At first defining

$$\rho(x, y, z) = \text{const. when } x^2 + y^2 + z^2 < R^2 \\ \text{and} = 0 \quad \text{when } x^2 + y^2 + z^2 > R^2$$

and then making $R \rightarrow \infty$.

No satisfactory solution has appeared to us.

I wish to thank Sri. P. K. Ghosh of the University of Calcutta with whom I had a detailed discussion of the problem and who indeed suggested the solution ($R \rightarrow \infty$, etc.).

Indian Inst. of Tech., G. BANDYOPADHYAY.
Kharapur, January, 16, 1953.

COMMENTS ON THE ABOVE PARADOX

We are dealing here with two fields, one a scalar density field $\rho(x, y, z) = c$ (for all x, y, z), and the other the gravitational (vector) field connected with the distribution. Since the whole of infinite space is involved, we have to deal with infinite triple integrals and questions of convergence and uniqueness arise. It is found that there is no *unique* force field connected with the postulated mass distribution, and so no question of potential or Poisson's equation arises.

Let P and C be two points distant d apart. Consider the mass distribution for which $\rho = c$ for points inside a sphere centre C and radius R, and $\rho = 0$ outside. The force at P is along PC and increases till R increases to d after which it remains constant ($= \gamma 4\pi dc/3$, γ being the constant of gravitation) since a uniform spherical shell exerts no attraction at an interior point. Hence when $R \rightarrow \infty$ so that the density is c everywhere, the limit of the field vector at P is $\gamma 4\pi dc/3$ towards C. Thus, by taking different positions of C (while keeping P fixed) and making $R \rightarrow \infty$, we get different fields all related to the given density distribution. Hence, *there is no unique force field associated with the given mass distribution* and no question of potential or Poisson's equation arises.

To put the same thing in a different way, consider any uniform finite mass distribution of which P is an interior point. We can pair off any matter around a point Q_1 with corresponding matter round Q_2 , where Q_1 and Q_2 are symmetrically situated about P. Their attractions at P cancel out. But after this has been done, there may remain residual matter on one side. Mr. Bandyopadhyay assumes that if this unbalanced matter is sufficiently far off, say, the nearest point being at a distance R from P, then its attraction at P tends to zero when $R \rightarrow \infty$. In other words, it is assumed that an infinite distribution of ultimately zero density has a zero field. Since we may add a zero mass distribution without affecting any existing distribution, the above assumption is implicit in postulating the exist-

ence of a unique associated force field. The above assumption, however, is incorrect as the following example will show:

Let APB be in a straight line with $AP = PB = d$, and let r_A and r_B denote the distance of any point Q from A and B. Consider the region of points Q defined by $r_A > R$, $r_B < R$, ($R > 2d$), bounded by 2 spherical caps. The nearest point of this region from P is $R - d$ and the attraction at P of matter of density c filling this region is seen to be $\gamma 4\pi dc/3$ towards B, and is independent of R. Making $R \rightarrow \infty$ we see that matter with density which is ultimately zero everywhere (i.e., entirely at infinity) is exerting a finite force at P.

In some paradoxes the mistake is in the argument, but in others like the one under discussion, it is there right at the very start, in assuming the existence of a unique force field associated with the given distribution. This ambiguity will arise for every mass distribution covering the whole of space, under the inverse square law of attraction.

Madras Inst. of Technology, A. NARASINGA RAO.
Chromepet, Madras.

VARIATION OF VISCOSITY OF LIQUIDS WITH TEMPERATURE

ANDRADE¹ has suggested the formula

$$\eta_T v^{1/3} = A e^{c/RT} \quad (1)$$

for the variation of viscosity of a liquid with temperature, where the symbols have their usual meanings.

A modified form of Sutherland's² formula for gases is suggested here to account for the variation of viscosity of liquids with temperature, which is found to be more accurate than (1). Sutherland's theoretical formula is

$$\frac{\eta_T}{\eta_{273}} = \left(\frac{T}{273} \right)^{3/2} \frac{K + 273}{K + T} \quad (2)$$

K is a constant for a particular gas and is positive. But for liquids it comes out to be negative, because their viscosity decreases with increasing temperature. Also, K is not a constant. It slowly decreases with the rise of temperature and may be denoted by $K = f(T)$.

Empirically this function has been found to be $K = S(\log_{10} T)^n$, where S and n are characteristic constants for a particular liquid. Equation (2) accordingly becomes

$$\frac{\eta_T}{\eta_{273}} = \left(\frac{T}{273} \right)^{3/2} \frac{S(\log_{10} T)^n + 273}{S(\log_{10} T)^n + T} \quad (3)$$

Table I gives the value of n for different liquids. The validity of the formula is shown by the constancy of S in the case of different types of liquids like water, alcohols, glycerine

and mercury. Table II shows the variation of S with T for two liquids. The detailed results are similar for the others.

TABLE I

| Liquid | .. | " |
|----------------|----|-------|
| Water | .. | 1.0 |
| Methyl alcohol | .. | 1.0 |
| Ethyl alcohol | .. | 2.302 |
| Glycerine | .. | 1.0 |
| Mercury | .. | 1.584 |

TABLE II

| T° K | Water | | Mercury | |
|------|----------|-------|----------|-------|
| | η^* | -S | η^* | -S |
| 253 | .. | .. | .0186 | 41.64 |
| 273 | .01793 | .. | .0169 | .. |
| 283 | .01311 | 102.3 | .0162 | 42.51 |
| 293 | .01006 | 102.6 | .0156 | 41.67 |
| 303 | .00800 | 102.6 | .. | .. |
| 313 | .00657 | 102.1 | .. | .. |
| 323 | .00550 | 102.7 | .0141 | 42.17 |
| 333 | .00469 | 102.5 | .. | .. |
| 343 | .00406 | 102.8 | .. | .. |
| 353 | .00356 | 102.3 | .. | .. |
| 363 | .00316 | 101.8 | .. | .. |
| 373 | .00284 | 101.9 | .0122 | 42.64 |
| 473 | .. | .. | .0101 | 42.51 |

* In C.G.S. units.

The experimental values of viscosities of different liquids have been taken from Kaye and Laby's 'Physical and Chemical Constants'.

The author's grateful thanks are due to Dr. K. Majumdar for his interest and valuable advice and to Mr. M. S. Sodha and Mr. Y. P. Varshni for their helpful suggestions.

Dept. of Physics, SHASHANKA SHEKHAR MITRA.
University of Allahabad,
Allahabad, August 7, 1953.

1. Andrade, *Phil. Mag.*, 1934, 17, 497, 698. 2. Sutherland, *Ibid.*, 1893, 5, 36, 507.

PITCHSTONE FLOW IN RAJMAHAL HILLS, BIHAR*

WHILE mapping the different flows of basalts in Rajmahal Hills, Santal Parganas, Bihar, during 1952-53, the author noticed a flow of pitchstone occurring near Berhait (24° 53'; 87° 36'; Survey of India Topo Sheet No. 72 P/9) and Taljhari (25° 05'; 87° 45'; Sheet 72 0/12). This note is communicated since this is the first recorded occurrence of pitchstone flow in India and its association with basalts is also of considerable petrological interest.

The flow is exposed over a distance of two miles in a nala, two miles SSE of Berhait.

Two more exposures are found near Berhait and in the section of the Gumani River, two miles NNE. The area in between the exposures is covered by soil. Near Taljhari, about twenty miles NNE of Berhait, the flow is exposed over a distance of three miles all along the base of the hills. The exposed thickness of the flow in the Railway Quarry is 30 ft.

The pitchstone is glassy, with a pitchy lustre and breaks with a conchoidal fracture. The rock weathers into a greenish grey mass. The upper surface of the flow is highly amygdaloidal and it is seen in the Railway Quarry near Taljhari that the amygdules are restricted to the top (5 ft.) portion of the flow and become scarce at lower levels. Locally the vesicles are elongated in the direction of the flow. In places near Berhait, the rock lacks the glassy appearance and contains mega-phenocrysts of feldspar.

In thin sections the pitchstone is seen to consist of a few phenocrysts of plagioclase (oligoclase), hypersthene and augite in a matrix of brownish glass containing numerous micro-lites of sodic plagioclase (albite and oligoclase), pyroxenes and magnetite. Perlitic cracks and spherulites are also noticed. The rock is feebly magnetic.

The specific gravity of these rocks varies from 2.400 to 2.538 while that of the basalt is above 2.900. The maximum refractive index of the glass is 1.520. The percentage composition of the glass, as computed from the refractive index¹ would be as follows:

SiO₂, 64; CaO, 3.9; MgO, 1.6; K₂O, 3.6; and Iron, 6.0.

Further detailed studies are now in progress. Geological Survey of India, C. S. RAJA RAO.
Calcutta-13, July 29, 1953.

1. George, W. O., *Jour. Geol.*, 1924, 32, No. 5.

* Communicated with the kind permission of the Director, G. S. I.

GARNET-SILLIMANITE-CORDIERITE RELATIONSHIP IN KHONDALITES

THOUGH Cordierites have been reported from several localities in the garnet-bearing paragneisses of South India, very little has been said about the relationship between garnets and cordierites in these rocks.

During a regular geological survey of the Khondalites and associated rocks in the Bobbili-Salur area of Srikakulam District by the author, an interesting suite of cordierite-bearing rocks such as garnet-sillimanite-cordierite gneiss and cordierite-sillimanite gneiss were distinguished.

in the field. A detailed optical examination of micro-sections of these types has yielded some very interesting data which throw light on the genetic relationship of cordierites to the garnets and sillimanite.

In the garnet-sillimanite-cordierite gneiss, sillimanite occurs as fibrolitic inclusions in the garnets. It is seen to occupy, in stages, almost the whole of the garnet. Cordierite occurs in minor quantities, interstitially between crystals of garnets, in these rocks. In the next group of rocks, viz., cordierite-sillimanite gneisses, garnet as such is almost entirely absent but palimpsests of this mineral are definitely recognised. The progressive alteration or change of garnetiferous rocks into garnet-sillimanite-cordierite and cordierite-sillimanite rocks are successively traced in the micro-sections.

The relict garnet and cordierite appear to have genetic relationship as is evidenced by the following observations: (a) the occurrence of the two minerals in association; (b) the increase of cordierite with corresponding decrease of garnet in the stage represented by cordierite-sillimanite gneiss; (c) the development of cordierite in the interstitial spaces of garnet, at times exhibiting a vermicular structure; and (d) the elongated porphyroblasts of cordierite apparently pseudomorphous after garnet with numerous inclusions of sillimanite, lying in the trend of the original garnet-bands.



FIG. 1

Garnet-Sillimanite-Cordierite Gneiss

C—Cordierite, G—Garnet, Si—Sillimanite, P—Pleochoic Haloes, F—Felspar.

It is suggested that the sillimanite is formed from the alumina and silica released by the breaking up of the garnet. This process takes place till the residue of the garnet molecule affords adequate material for the formation of cordierite. It is suggested that the end pro-

ducts of the breaking up of garnet are essentially cordierite and sillimanite (Fig. 1).

A detailed paper embodying the results of chemical analyses and optical studies will be published elsewhere.

My thanks are due to Prof. C. Mahadevan for the keen interest he has evinced in the work and for his helpful criticism.

Dept. of Geology, K. V. RAGHAVA RAO.
Andhra University,
Waltair, August 26, 1953.

FREEZING POINT OF CAPILLARY CONDENSED WATER

A CONSIDERABLE amount of experimental work on the freezing point of capillary condensates has been reported in literature in recent times.¹⁻⁶

We have devised a simple dilatometric method, capable of yielding reproducible results, for determining the freezing point of capillary condensed water. By means of this technique, we have measured the freezing points of water held at different vapour pressures, in four different porous adsorbents (silica gel, alumino-silicate gel, a sample of bentonite and a sample of clay), varying largely in their pore size—distribution relationships. The results show that freezing point depression of water depends upon the radius of the capillary pores in which it is condensed, and that it is independent of the nature of the adsorbent or the amount of the moisture contained in it.

The freezing point depressions of water (average values for the four adsorbents) condensed in pores of radii less than 413, 69.4, 37.3, 24.5, 17.8, 13.9, 11.5 and 9.7 Å were found to be 0.50°, 5.63°, 10.96°, 16.0°, 22.1°, 28.2°, 32.7° and 43.8° C., respectively. These values were seen to agree well with the theoretical values calculated from thermodynamic considerations based on the theory of capillary condensation.

A detailed account of the work will be published elsewhere.

Dept. of Chemistry,
Panjab University,
Hoshiarpur,
July 1953.

BALWANT RAI PURI.
LEKH RAJ SHARMA.
M. L. LAKHANPAL.

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OCCURRENCE OF *CLYPEINA*
(DASYCLADACEAE) IN THE NINIYUR
GROUP (DANIAN) OF THE SOUTH
INDIAN CRETACEOUS

AMONG the abundant Dasycladaceae recently reported¹ from the flints and cherts of the Niniyur group, and now under detailed study, we have noticed the occurrence of *Clypeina*. This interesting form is very well seen in some of the slides, revealing both longitudinal and transverse sections.

Fig. 1 is a longitudinal tangential section (the form as preserved is incomplete) and shows very nicely all the striking features of the genus. The thallus is cylindrical, though slightly tapering, and as many as 6 whorls (verticils) of branches are visible. The distance between two adjacent whorls is about 0.2-0.3 mm. Each whorl is composed of about 18-20 branches (which served as sporangial chambers) which are all upwardly directed and spread out, so as to give the whorl a beautiful cup-shaped form. The branches also show a distinct tendency to diverge gradually away from the axis at their upper margin, thus im-

seen along the outer margin away from the axial cavity. The entire diameter is about 0.9 mm. while that of the axial cavity alone is about 0.5 mm. The diameter of the sporangial cavities is about 0.08 mm.

Fig. 3 shows an oblique longitudinal section of another *Clypeina* obviously specifically different from the form in Fig. 1. Only 2 whorls are seen here (as preserved), with an intervening distance of about 0.35 mm. The number of branches in each whorl is only about 12; the shape, size and 'infundibular' form of the verticils are quite distinctive.

Fig. 4 is a transverse section and shows 12 distinct sporangial cavities along the outer margin, each with a diameter of about 0.08 mm.; but in this case, the outline of the form, as seen in transverse section, is elliptical, and not circular,—the longer diameter measuring about 0.60 mm. The axial cavity is also accordingly spindle-shaped and measures about 0.30×0.08 mm. This elliptical shape does not appear to be an effect of distortion during fossilization; it seems to represent the true form of the alga.

FIG. 1. ($\times 40$)



FIG. 3. ($\times 50$).



FIG. 2. ($\times 40$)



FIG. 4. ($\times 50$)

parting a very characteristic shape to the entire whorl, well seen in the photograph.

Fig. 2 shows the transverse sections of this form, and the sporangial chambers are well

If so, this would be a very interesting and unusual feature. What we see in Fig. 4 is probably a transverse section of the form shown in Fig. 3.

Only about 5 or 6 species of *Clypeina* have been described from outside India so far, and it is interesting to note that practically all of them (except one from the Jurassic) come from beds of Eocene age. So far as India is concerned, the occurrence of this genus was recorded for the first time by C. P. Varma² from the Danian Niniyur rocks identical with the beds from which the present forms are being described. He has considered his form as a new species of *Clypeina* and named it *C. sahni*.

In addition to the two types briefly described above, our material seems to contain many other kinds of Clypeinas and when all these are fully studied, they will undoubtedly add considerably to our knowledge of this interesting alga about which we know so little. It may also be possible then to discuss more fully and conclusively the systematic position of *Clypeina* in the Dasycladaceæ, about which there has been some difference of opinion.

This work is under progress, and a detailed paper will soon be published elsewhere.

Bangalore,

L. RAMA RAO.

September 21, 1953.

S. SAMBE GOWDA.

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VARIATIONS OF SEA LEVEL IN THE BAY OF BENGAL

HOURLY tide heights in Visakhapatnam Harbour for 1950 have been averaged by days so as to give a detailed annual cycle of sea-level. It was found that the water-level undergoes an exceptionally large annual variation with one high period in June, but the maximum high level is in October and November. The lowest period is in March and a secondary low in August. The total range is nearly 2'.

To account for the annual cycles of sea-level, the atmospheric pressure difference,^{1,2} wind speed and direction, rainfall,³ and density of the water⁴⁻⁶ are considered. Aside from astronomical influences, it is reasonable to assume that changes in mean sea-level ($\Delta H_{s.l.}$) may be expressed by the following relation:

$$\Delta H_{s.l.} = \Delta h_p + \Delta h_w + \Delta h_r + \Delta h_\rho$$

where Δh_p is the change in height of water due to atmospheric pressure difference; Δh_w change due to wind; Δh_r change due to rainfall and run-off; and Δh_ρ change due to the density or expansion of water.

The difference in atmospheric pressure between one side of the Bay of Bengal and other was converted to inches of water-level difference. This accounts for 6" of water between winter and summer. Between the March

and October sea-level extremes, atmospheric pressure accounts for 10 per cent. of the sea range. The rainfall, run-off and direct wind effect could not be accurately evaluated, but are believed to be small in Visakhapatnam Harbour.

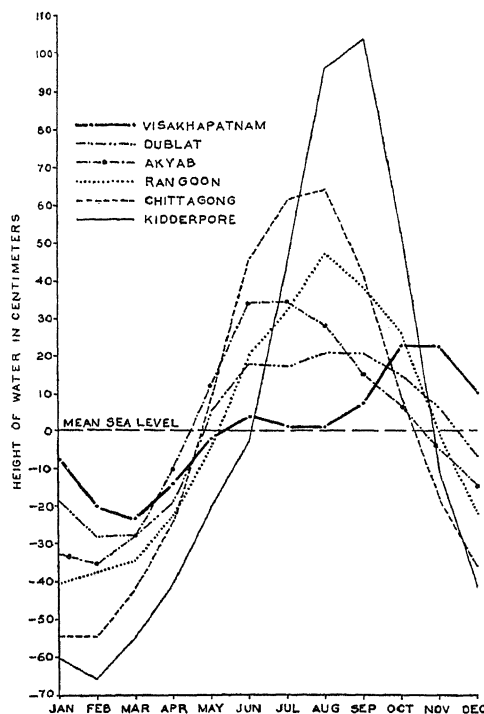


FIG. 1. Monthly average sea level over a number of years.

The major factor, however, causing the seasonal cycle of water-level has been attributed to changes in the mean vertical density of the water masses present, off the east coast of India. Vertical temperature and salinity from which the density was derived were obtained during the Andhra University oceanographic operation in 1952-53. The dynamic heights calculated from them give values of 0.710 and 1.258 dynamic meters for 0-200 meters for the months of April and October respectively, or a water-level difference of nearly 22" which can be attributed merely to the change in density of the water. This surprisingly amounts to about 90 per cent. of the total range in sea-level observed in 1950. All the range in sea-level can then be accounted for, since 10 per cent. is due to atmospheric pressure differences. However, it must be remembered that the sea-level data are for 1950, whereas the vertical density is for 1952-53.

Some density changes take place due to seasonal heating and cooling. However, most

changes are attributed to currents both horizontal and vertical which transport different water masses to and from the area. During the N-E monsoons light (low salinity, high temperature) water is transported from the north along the east coast of India. This caused high sea-level. During the spring when the S-W monsoon starts heavy (high salinity, low temperature) water exists along the coast, partly due to the equatorial water moving up the coast and partly due to upwelling⁷ of deeper waters towards the surface. The secondary lowering of sea-level in August is believed to be due to a second period of upwelling.

At the same time as the August sea-level is lowering, the eastern side of the Bay of Bengal experiences its maximum height (Fig. 1). The seasonal range in sea-level is higher on the Burma coast where the greatest range in the world is found. Here, too, its cycle is caused by seasonal changes in the physical properties of the water, reinforced by atmospheric pressure and river run-off.

Short period fluctuations in water height are also observed in Visakhapatnam Harbour. Some are for a few minutes but the most frequent period is about 34 minutes with heights of 2-6". These are most common at high and low slack tide, and during neap tide when the range of the tide is lowest. The specific seiches are believed to be due to wave oscillations across the continental shelf^{8,9} between the coast and deep water, or possibly due to the peculiarity of the size and shape of the harbour.

Andhra University, R. PRASADA RAO.
Waltair, September 17, 1953. E. C. LA FOND.

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NITROGEN DISTRIBUTION IN THE URINE OF RAJASTHANIS

KNOWLEDGE concerning the urinary nitrogenous excretion is an essential factor in the elucidation of the metabolic studies in human beings. Moreover, the daily excretion of nitrogen is an index of the nutritional level of the individual

in regard to the proteins. The present investigation derives marked significance from the fact that the diet of the average Rajasthani is poor compared to that of an individual in other parts of India.

Earlier studies on the nitrogen partition in the urine of tropical population were carried out by Campbell,¹ McCay,² Ray and Ganguly,³ and Hughes.⁴ The results of a study undertaken in this laboratory on the nitrogen partition in the urine of Rajasthanis are based on the analysis of the urine of 24 normal individuals consisting of two distinct groups of persons, the one (A) comprising of male adults having sedantary occupation and hostel students receiving standard dietaries, and the other (B) consisting of mostly workmen who received low nitrogenous diet. All the subjects were vegetarians. The composition of diets fed to the two groups is given in Table I.

TABLE I
Composition of diets

| | Group A | Group B |
|--------------------|---------|---------|
| Calories | 2,056 | 1,539 |
| Total Proteins, g. | 50.7 | 44.6 |
| Total N, g. | 8.45 | 7.4 |
| Non-protein, N | Nil | Nil |

The significance of the results as laid in Table II from the present point of view is that the value of total N and urea N (for Rajasthanis) are low compared to European and American standards and indicate a low level of protein ingestion.

TABLE II

| | Rajasthani Group A | Rajasthani Group B | Europeans Cole ⁵ | Americans Folin ⁶ |
|------------------------------------|-----------------------|-----------------------|--------------------------------|---------------------------------|
| Body weight in kilos | 65.8 | 55.0 | 70.0 | 63.0 |
| Volume of urine per diem in ml. | 1407 | 726 | 1440 | 1430 |
| Specific gravity | 1.015 | 1.022 | 1.020 | 1.022 |
| Total N in g. per diem | 10.8 | 5.42 | 16.0 | 16.8 |
| Urea N in g. per diem | 7.9 | 3.42 | 14.0 | 14.7 |
| Ammonia N in g. per diem | 0.5 | 0.30 | 0.50 | 0.50 |
| Uric acid N in g. per diem | 0.26 | 0.14 | 0.23 | 0.18 |
| Creatinine N in g. per diem | 0.41 | 0.30 | 0.58 | 0.58 |
| Undetermined N in g. per diem | 1.5 | 1.3 | 0.70 | 0.85 |

In addition to urea N representing the main product of exogenous metabolism, ammonia derives its metabolic importance in that it is produced in amounts which are necessary for the excretion of acids from the body. Since the end products of protein metabolism are mostly acid, the ammonia output varies in the same direction as the total N output though no definite relation has been observed. The daily output of ammonia in the urine of Rajasthanis (Groups A and B) is almost the same as Europeans.

Representing the end product of purine metabolism, uric acid owes its origin partly to the purine substances of the food and partly to the metabolism of muscle proteins of tissues. Rajasthanis belonging to Groups A and B excrete 0.65 g. and 0.41 g. per diem (uric acid) respectively.

'Creatinine coefficient' defined as the creatinine N in mgm. excreted per kg. body weight per diem, by Schaffer,⁷ depends upon the muscular efficiency of the individual. The general average 'creatinine coefficient' for the Rajasthanis is far below the European and American standards. Full details of work and significance of results would be published elsewhere.

Biochemical Unit,
Division of Pharmacy,
Birla College, Pilani,
Rajasthan, May 20, 1953.

K. RAMAMURTI.
S. N. THAMPI.

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NON-VARIANT NATURE OF FIELD GRADIENT UNDER IRRADIATION CAUSING JOSHI EFFECT IN A.C. ELECTRIC DISCHARGE

THE marked importance of the potential distribution in the discharge space in determining the magnitude of the current i , has been emphasised by Loeb¹ and others.^{2,3} It controls the number (and therefore, i) of avalanches formed by the initiating electrons produced by any of the agencies (*vide infra*). Below the breakdown potential, the field intensity (E) is linear with the distance separating the two electrodes, cathode (c) and anode (a); when the applied voltage V is large enough to cause a self-maintained discharge, it varies differently

(as shown in Fig. 1), with its marked gradient in the cathode fall region. In view of the appreciable variation under light of the current i of a self-maintained discharge, giving

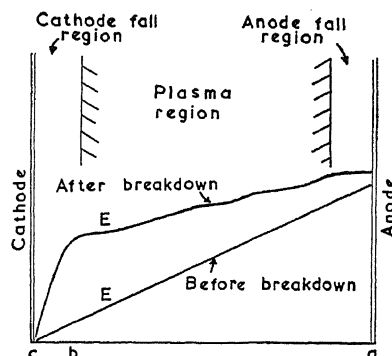


FIG. 1. Variation of Field (E) in Discharge space especially in plasma, cathode and anode fall-regions (*cf.* Ref. 3).

(positive and) negative Joshi effect, $(+) - \Delta i^4$, it was of interest to know the change, if any, of the field gradient under irradiation. The present communication points out the significance of a few results obtained during the studies of Joshi effect in iodine vapour, which indicate clearly the non-variant behaviour of the field gradient under conditions giving large Joshi effect. Iodine vapour was excited in cylindrical tubes having external sleeve electrodes to which a 50 cycle A.C. voltage is fed; and the current variations were investigated by a double beam cathode-ray oscillograph. Fig. 2 gives a typical set of oscillograms of the current in dark and under light, when the potential V was greater than the 'threshold potential' V_m of the self-maintained discharge; the studies of the r.m.s. value of i (measured by a galvanometer actuated by a diode) showed that the variation of the current due to light corresponded to 70 per cent. current suppression—negative Joshi effect. It was interesting to note that in dark, two types of pulses were observed usually (at $V > V_m$): (i) the longer pulses produced by the well-known secondary mechanisms⁵ concerned with the liberation of electrons from the cathode chiefly by positive ion bombardment (γ) and photons ($\gamma\theta g$) and (ii) shorter pulses due to other secondary processes (β) occurring in the gas phase⁶ (*cf.* Fig. 2); of these last, photoionisation of the pre-excited gas particles in the cathode fall region appeared significant to (ii).^{7,8} That is, an electron formed by this process acquires energy due to the field gradient and starts ionisation by inelastic collisions after travelling

a known distance away from the cathode in the field direction. The generated electron repeats the process forming electron-avalanches. The number of electrons produced in this last is fundamentally governed by the field gradient

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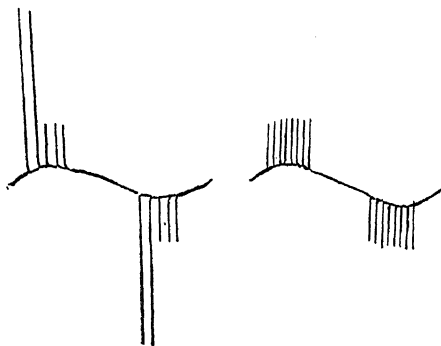


FIG. 2. Oscillograms representing the current structure in iodine vapour (0.04 mm. H_2 , 28°C .) in dark and under light, at 1.9 kV (50 c/s).

and determines the pulse height. The production of shorter pulses of essentially the same height suggested that the electrons generated by photo-ionisation in the above mentioned region, travel through sensibly the same potential difference and ionise gas particles from a fixed point (b) away from the cathode c (cf. Fig. 1).⁷ It has been emphasised that ionisation process between c and b is not excluded, but occurs by fast electrons released from the cathode by γ and α mechanisms.⁷ A significant feature of the oscillogram noticed under light was that (while the longer pulses were inhibited) more number of shorter pulses remarkably of the same height as those appeared in dark, was produced. This suggested that the aided creation under light of initiating electrons in the cathode fall region causes ionisation by impact with gas particles from the same point b to give the enhanced number of the shorter pulses (which is referred to as the occurrence of $+\Delta i$ simultaneously with $-\Delta i$).⁹ It could occur only when the field distribution between cathode and anode, whatever manner it may be, was unaltered by additional constraint, viz., irradiation, suggesting that enhanced space charges⁴ altering the field gradient¹ were not formed under light.

The observation that current flowing through a system can be inhibited appreciably by light without altering the field gradient is of marked significance and may lead to some applications of Joshi effect, which merit investigation.

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FOSSIL WOODS RESEMBLING MANGIFERA, SHOREA AND ALBIZZIA IN THE TERTIARY ROCKS OF S. ARCOT, INDIA

THE specimens of these woods were collected by the author from Mortandra (Cuddalore sandstones?) in the South Arcot District, about 5 miles north-west of Pondicherry. From Tiruvakkarai (Cuddalore sandstones), 13 miles W-N-W of Pondicherry Professor B. Sahni¹ has described a fossil coniferous wood, *Mesembrioxylon schmidianum*. He has also described from the Cuddalore series a palm *Palmoxylon pondicherriense*.² The present note gives a brief account of some dicotyledonous fossil woods from this area.

Woods resembling Mangifera.—The following characters of these fossil woods indicate a very close similarity to *Mangifera*; growth rings faint, with fairly large solitary vessels. Pits on the vessels large and alternate. Fibres unseptate. Parenchyma fairly abundant and of two types, (i) aliform and locally confluent; (ii) in initial or terminal bands. Medullary rays 1-2 seriate, short and typically homogeneous.

Woods resembling Shorea.—These specimens show strong resemblances with *Shorea* in the following characters: vertical gum ducts embedded in parenchyma and disposed tangentially in long conspicuous bands. Vessels abundantly tylosed and evenly distributed. Scanty-vasicentric tracheids common. Fibres unseptate but thick-walled with numerous simple to bordered pits. Parenchyma of two types, (i) paratracheal, and (ii) apotracheal,

the former represented by scanty-vasicentric cells, and the latter consisting of short or long tangential strips. Medullary rays broad and always heterogeneous.

Woods resembling Albizzia.—The following characters suggest a close affinity with *Albizzia*; vessels mostly solitary, often with a tendency towards oblique arrangement in transverse section. Pits on the vessels alternate, often with coalescent apertures. Fibres typically septate with simple pits. Parenchyma very abundant, predominantly vasicentric to aliform, locally confluent, vaguely storied. Diffuse parenchyma with crystalliferous cells also present. Medullary rays 2-5 seriate, always homogeneous with typically short (procumbent) cells.

The present distribution of the families Anacardiaceæ, Dipterocarpaceæ and Leguminosæ is chiefly tropical. Their occurrence in fossil condition in South Arcot District indicates that the climate of the area at the time when these plants were alive was not very much different from what it is today.

The author is indebted to Dr. R. V. Sitholey for his kind help and suggestions.

Birbal Sahni Inst. of C. G. K. RAMANUJAM.

Palæobotany,
Lucknow, May 13, 1953.

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STUDY OF SULFHYDRYL COMPOUNDS IN NEERA BY PAPER CHROMATOGRAPHY

THAT neera is a fairly rich source of sulfhydryl (SH) compounds, was reported by Guttikar and Sohonié.^{1,2} The stability of ascorbic acid in neera has been attributed by them to the presence of 'SH' compounds. It was, therefore, felt of interest to study the nature of these 'SH' compounds by paper chromatography.

Freshly drawn neera was treated with equal volume of ethyl alcohol to remove pectinous material. The 'SH' compounds were then subjected to further purification by treatment with 6 per cent. mercuric nitrate.³ The mercury complex was removed by centrifuging and it was then thoroughly washed with water. The precipitate was stirred in 10 ml. of N HCl and decomposed by passing H₂S gas. The black precipitate of mercury sulfide was removed and the filtrate obtained was treated with mercury nitrate again. The above procedure was repeated and the clear solution obtained was

made free of H₂S by passing nitrogen gas through it, until the vapours gave no more positive test with lead acetate paper. The final 'SH' concentrate had a volume of 25 ml. approximately and was 0.5 N with respect to HCl. This solution was used for chromatography.

The technique as described by Giri and Rao⁴ for circular paper chromatography was followed throughout the investigation. The paper used was 'Whatman No. 1' filter-paper, while the solvents used were (1) N-Butenol-acetic acid-water mixture in the proportion of 40:10:50 and the upper layer used in the trough; (2) phenol-water mixture in the proportion of 80:20; (3) iso-butric acid.

The papers were spotted with the above purified neera extract and with the standard solutions of glutathione and cysteine and they were irrigated with the above solvents. In all the cases, the solvents were allowed to travel for 4 hours. The papers were then removed and dried at room temperature. They were developed using the reagents mentioned in Table I.

The *R_f* values with the three different solvents are given in Table I, from which it will be seen that the values agree very well with those of glutathione.

TABLE I

| | Butenol acetic acid- water (A) | Phenol- water (B) | Isobutric acid (B) |
|------------------|-----------------------------------------|-------------------------|--------------------------|
| Std. Glutathione | 0.38 | 0.66 | 0.54 |
| Std. Cysteine | 0.58 | 0.84 | 0.75 |
| Neera extract | 0.38 | 0.64 | 0.52 |

A : Developed with 0.1 % ninhydrin in N-butanol⁵

B : Developed with Iodine-Azide reagent⁶

Further proof was obtained when the purified neera extract was hydrolysed with HCl and the hydrolysate was studied by paper chromatography, whereby the component amino acids, glycine, glutamic and cysteine were identified.

Glutathione in neera was estimated by titration with *p*-chloro-mercury benzoic acid⁷ using sodium nitroprusside as an indicator. The reagent is specific for the estimation of glutathione in biological material. The iodometric method⁸ is useful to estimate the entire 'SH' compounds in the material containing ascorbic acid after deducting the iodine equivalent of ascorbic acid. It was observed that the value obtained for glutathione by titration with *p*-

chloro-mercury benzoic acid agreed well with the iodometric estimate of 'SH' compounds. It is, therefore, concluded that 'SH' compounds in neera exist entirely as glutathione.

The samples of neera were obtained through the courtesy of the President, Gandhi Smarak Nidhi, Bombay State.

Dept. of Biochemistry, KAMALA SOHONIE.
Inst. of Science, B. V. HATWALNE.
Bombay-1, August 6, 1953.

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INDIAN BAUXITES FOR THE DEHYDRATION OF ALCOHOL TO ETHYLENE

THE use of certain naturally occurring bauxites and clays as catalysts for the dehydration of ethyl alcohol to ethylene is well known. Many references, some of which are given here¹⁻⁶ are available on the use of synthetic aluminas, bauxites and clays for this reaction. Little or no data have been reported on the specificity and capacity of Indian bauxites for this reaction.

Several Indian bauxites were tested for their specificity and activity in the catalytic dehydration of ethyl alcohol to ethylene. In tests carried out with a catalytic reactor having a capacity of 1 lb. of ethylene per hour, the conversions obtained with the 3 Indian bauxites mentioned below averaged better than 90 per cent. at space velocities even above 1 gm. of alcohol (expressed at 100 per cent.) per c.c. of catalyst per hour. The average unsaturated hydrocarbon content of this gas was 96 per cent.

These bauxites are from the Shevaroy Hills, Salem District, Madras State. According to the information available⁷ the percentage composition of the dry samples lay between 53-58 Al₂O₃, 3-9 Fe₂O₃, 3-11 silica, the alumina being present as gibbsite and the impurities as mechanical admixtures.

The bauxites before use, were activated in a muffle furnace at 450° ± 10° C. for 4 hours.

With imported activated alumina catalysts, the same conversion (about 90 per cent.) could be obtained at space velocities up to about 0.75 g./c.c./hour. Higher space velocities resulted in lower conversions. However, these

catalysts gave a higher percentage of ethylene in the product gas.

The majority of catalysts (both aluminas and bauxites) reported in literature had activities of a lower order than those observed by us with the above three Indian bauxites and hence they can be used advantageously in place of synthetic alumina. For instance, Bentley and Feacham¹ obtained an activated alumina catalyst that gave a conversion of 98 per cent. with alcohol feed rates up to 0.480 c.c./c.c. of catalyst/hour at 357° C.

The only reliable data on large-scale plant practice is contained in the BIOS Report No. 776⁶ which reports a figure of 0.55 g./c.c./hour as the average space velocity used in catalytic converters using synthetic alumina and yielding over 90 per cent. conversion of alcohol to ethylene at 360° C.

The present investigation leads us to conclude that the three Indian bauxites specified herein can be used with advantage in industry in place of the more expensive synthetic aluminas for the catalytic dehydration of alcohol to ethylene.

Life tests on these bauxites are in progress and we hope soon to publish the detailed data.

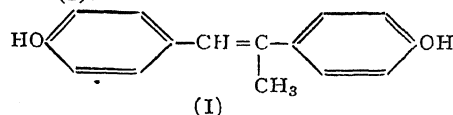
Chem. Engg. Div.,
NCL, Poona-8,
August 17 1953.

M. U. PAI.
H. K. JOSHI.

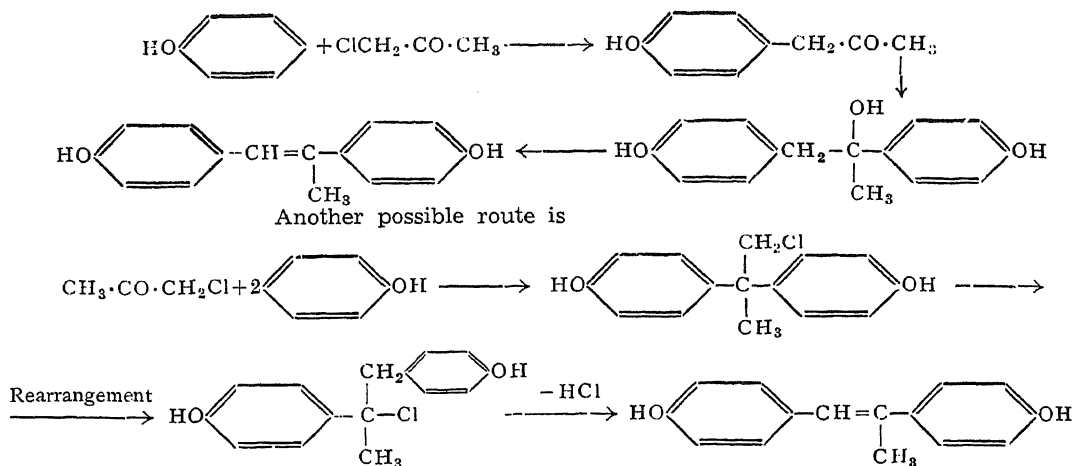
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PREPARATION OF 4, 4'-DIMETHOXY- α - METHYLSTILBENE

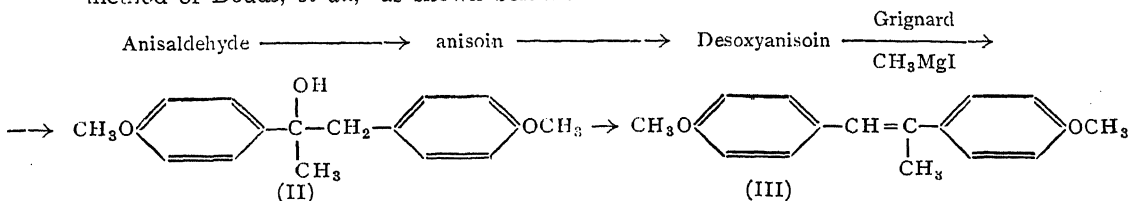
THE product of condensation of chloroacetone with phenol in the presence of concentrated sulphuric acid has been reported from these laboratories¹ to be 4, 4'-dihydroxy- α -methylstilbene (I).



Carbon and hydrogen percentages agree with the formula (I); the product yields a dimethyl ether, m.p. 124-25° C., agreeing with that reported by Dodds, Golberg, Grunfeld, Lawson, Saffe and Robinson² for this compound. The following mechanism was suggested.¹



Synthetic evidence in support of structure (I) has now been obtained by preparing an authentic sample of 4, 4'-dimethoxy- α -methylstilbene following the method of Dodds, *et al.*,² as shown below:



During the course of this work, it has been noticed that in some cases when benzene is substituted for anhydrous ether at the Grignard stage and the reaction allowed to proceed at the boiling temperature of benzene for two hours, the product, on working up the reaction mixture in the usual way, is the stilbene derivative (III), and not the expected alcohol (II). This substance has been recrystallized from petroleum ether (b.p., 40-60° C.), and obtained as shining plates, m.p. 124-25° C. (Dodds, *et al.*,² reported 123-24° C.), and does not depress the melting point of the dimethyl ether of the condensation product obtained by Bhargava and Zaheer.¹

It has thus been established that the condensation between chloroacetone and phenol under the conditions employed by Bhargava and Zaheer,¹ whatever the mechanism, leads to the formation of a stilbene derivative.

Full details of this and related investigations will be published in due course.

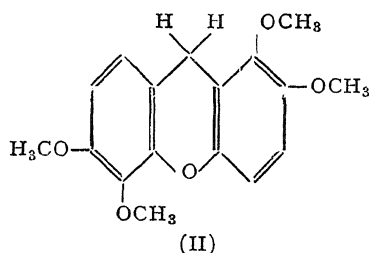
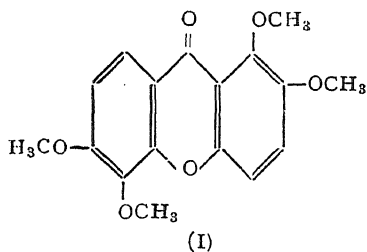
Central Lab. for Scientific V. D. N. SASTRI.
and Industrial Research, N. SHANMUKHA RAO.
Hyderabad-Deccan, S. HUSAIN ZAHEER.
July 1, 1953.

LITHIUM ALUMINIUM HYDRIDE AS A REDUCING AGENT FOR ANTHOXANTHINS

IN continuation of our studies on the constitution of naturally occurring xanthenes-decussatin and swertinin,¹ it has been found that methyl ether of decussatin on reduction with lithium aluminium hydride, gives a xanthene derivative, the CO-group being reduced to CH². This was rather unexpected because carbonyl compounds on reduction with this reagent generally give carbinols.² Mirza and Robinson who were the first to study the reduction of γ -pyrones by lithium aluminium hydride have reported their reduction to γ -pyronols. In the present case, the reduction goes a step further to the methylene derivative. In view of the anomalous result in the case of xanthone, this study was extended to some flavones which are also found to give flavenes. A few isolated observations have been made in the past wherein further reduction of carbinols to methylene derivatives has been reported.⁴

Decussatin methyl ether (I), b.p. 165° C., on boiling with excess of lithium aluminium hydride in ether for about 12 hours, gave the

1. Bhargava and Zaheer, *Nature*, 1953, **171**, 746.
2. Dodds and co-workers, *Proc. Roy. Soc.*, 1944, **132B**, 87.



xanthene derivative (II), crystallising from alcohol, m.p. 125-26° C. 4'-Methoxy-6-methyl flavone, m.p. 170° C., and 4'-methoxy flavone, m.p. 157° C., gave the corresponding flavenes, m.p. 130° C. and 123-24° C., respectively. A systematic investigation of the reduction of anthoxanthins with this reagent and synthesis of catechin-type compounds is in progress. A detailed account will appear elsewhere.

National Chem. Lab. of India, A. B. KULKARNI.
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July 24, 1953.

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DISTRIBUTION OF PHOSPHOPROTEIN PHOSPHATASE IN MAMMALIAN TISSUES*

PHOSPHOPROTEIN phosphatase, an enzyme specific for the dephosphorylation of phosphoproteins was first detected in frog eggs by Harris.¹ The presence of a similar enzyme was reported in rat tissues by Feinstein and Volk² and by Norberg.³ The enzyme had a wide distribution occurring in almost all the tissues, the highest activity being found in the spleen. These workers have also suggested an inter-relationship between phosphoprotein phosphatase activity and tissue growth.⁴⁻⁶ In the present investigation the distribution of the enzyme has been studied in some of the tissues of adult rat, rabbit, cattle, sheep and pig. By employing a purified preparation of the enzyme from ox spleen we have already shown that the enzyme in question acts specifically on phosphoproteins and has very little action on their proteolytic breakdown products or on glycerophosphate.⁷

The tissue extracts for the assay were prepared by grinding in a mortar a weighed amount of the freshly dissected tissue with ten times its weight of 0.5 M sodium chloride buffered at pH 5.6. The use of this medium facilitated

the almost quantitative extraction of the enzyme besides ensuring its stability. After centrifugation of the tissue homogenate for a short period the activity of the supernatant was determined on a 0.5 ml. aliquot with casein as substrate and at pH 6 in the presence of 0.001 M thioglycolic acid as activator.⁷

Table I below shows the distribution of the enzyme in the various tissues examined. Enzyme activity has been expressed in terms of micrograms of phosphorus liberated in 30 min. from a solution of casein containing 10 mM of organic phosphorus.

TABLE I

| Species | | Tissue | Activity per g. fresh tissue |
|---------|----|--------|---------------------------------|
| Cattle | .. | Spleen | 1182 |
| | | Liver | 1126 |
| | | Kidney | 734 |
| Sheep | .. | Spleen | 1386 |
| | | Liver | 882 |
| | | Heart | 412 |
| Pig | .. | Spleen | 1236 |
| | | Liver | 1302 |
| | | Kidney | 1236 |
| Rat | .. | Spleen | 4068 |
| | | Liver | 1484 |
| | | Kidney | 1526 |
| Rabbit | .. | Spleen | 1868 |
| | | Liver | 714 |
| | | Kidney | 608 |

It will be evident from the results that the highest enzyme activity is found in rat spleen. The results obtained in the case of rat tissues are quite comparable to those obtained by Feinstein and Volk² who employed 0.01 M ascorbic acid as activator in their studies. Rat spleen was, however, only slightly more active than the liver according to Norberg.³ No activator was used by Norberg in his experiments and this may possibly explain the low results obtained with spleen.

The distribution of the enzyme in other animal tissues has been presented here for the

first time. It is of interest to note that animal tissues contain small but significant amounts of phosphoprotein.^{6,8,9} This fraction shows a very high rate of uptake of P^{32} and is thought to be an important intermediate in the utilization of phosphate.⁹⁻¹¹ The co-existence of phosphoprotein phosphatase and its natural substrate in animal tissues suggests that the enzyme may be concerned in the dephosphorylation of tissue phosphoprotein and hence phosphorus turnover of this substance. This is further confirmed by the recent findings of Johnson and Albert⁹ who report the highest phosphoprotein content in rat spleen—the tissue in which the highest phosphoprotein phosphatase content occurs. These workers were, however, unable to establish any close relationship between phosphatase activity and protein phosphorus turnover in the tissues. This discrepancy might, according to them, be explained on the basis that an inhibitory mechanism for the enzyme exists *in vivo* that is not active *in vitro*. Verification of this interesting hypothesis would undoubtedly throw further light on the exact physiological role of the enzyme.

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P. S. SARMA.

University Biochem. Lab.,
Madras-25, September 10, 1953.

* Part of work carried out by one of us (T.A.S.) for the M.Sc. Degree during the tenure of a University research studentship.

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BARBIER-WIELAND DEGRADATION OF TRICYCLOEKASANTALIC ACID

IN connection with certain investigations on sandalwood oil, the author required nor-tricycloekasantalic acid. This acid had been prepared by Semmler¹ from α -santalol by ozonolysis and subsequent permanganate oxidation of the enol-acetate of the resultant tricycloekasantalal. As the isolation of pure α -

santalol requires repeated fractionation (of the alcoholic portion of sandalwood oil) and further purification of the α -santalol fraction so obtained, through the strychnine salt of its hydrogen phthalate, this method appeared to be tedious. It has now been prepared by the Barbier-Wieland degradation^{2,3} of tricycloekasantalic acid which is a readily available crystalline compound.

Ethyl tricycloekasantalate [b.p., 110-11°/1.5 mm.; n_D^{23} , 1.4715; (α)_D + 12.27° (chloroform, $l = 5$ cm., $C = 3.258$)] gave on treatment with phenyl magnesium bromide a viscous tertiary alcohol, $C_{24}H_{28}O$ (b.p., 184-86°/1.2 × 10⁻² mm. Found: C, 86.57; H, 8.23. $C_{24}H_{28}O$ requires C, 86.70; H, 8.43 per cent.) which underwent dehydration with acetic anhydride and furnished an unsaturated hydrocarbon $C_{24}H_{26}$ [b.p., 180-5°/1.5 mm.; n_D^{23} , 1.5855. Found: number of double bonds, 1.035 (per benzoic acid method), C, 90.81; H, 8.35. $C_{24}H_{26}$ requires C, 91.70; H, 8.28 per cent.]. On ozonolysis in ethyl acetate medium this unsaturated hydrocarbon gave free nor-tricycloekasantalic acid and nor-tricycloekasantalal (b.p., 80-85°/5 mm.; semicarbazone, m.p. 223-24°; Found: C, 65.24; H, 8.30; N, 19.2. $C_{12}H_{10}N_2O$ requires C, 65.16; H, 8.6; N, 19.0 per cent.) along with benzophenone, unreacted hydrocarbon and a solid by-product, m.p., 116°, which was found by periodate test to be a 1, 2-diol, $C_{24}H_{28}O_2$ [Found: M.W. (Rast method), 346.4; C, 82.03, 82.08; H, 8.40, 8.34. $C_{24}H_{28}O_2$ requires M.W., 348; C, 82.75; H, 8.04 per cent.]. The nor-tricycloekasantal was oxidised with alkaline silver oxide by Delepine and Bonnet's method⁴ to nor-tricycloekasantalic acid. The overall yield of nor-tricycloekasantalic acid [m.p., 93°; (α)_D - 23.1° (alcohol, $l = 5$ cm., $C = 1.712$). Found: Eq. wt., 179.4; C, 73.59; H, 8.90. $C_{11}H_{10}O_2$ requires Eq. Wt., 180; C, 73.33; H, 8.88 per cent.] was about 64 per cent. of the unsaturated hydrocarbon.

The author thanks Dr. B. H. Iyer for his kind interest in this work.

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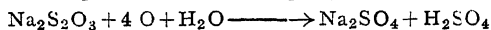
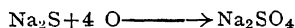
September 21, 1953.

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ESTIMATION OF SULPHIDE, SULPHITE AND THIOSULPHATE BY CHLORAMINE-T

THE method of Kurtenacker and Wollack¹ for the analysis of a mixture of sulphide, sulphite and thiosulphate, using standard solutions of iodine and thiosulphate only, is simple and rapid; but, it does not yield very accurate results at very low concentrations of sulphide and thiosulphate since the consumption of iodine by each mole of these corresponds only to two and to one equivalents of iodine respectively.

It has been shown in an earlier communication² that hydrogen sulphide is quantitatively oxidised to sulphuric acid by chloramine-T in acid medium. Further investigations have revealed that thiosulphate is also oxidised to sulphate quantitatively under similar conditions. Thus, when chloramine-T is employed as an oxidising agent in an acid medium, both sulphide and thiosulphate are quantitatively oxidised requiring 8 equivalents of the oxidant for complete oxidation according to the equations:



The accuracy of the method should, therefore, be enhanced considerably both in the case of sulphide and thiosulphate. This was actually found to be the case. A brief account of the method developed on the above lines as well as the results obtained are given below.

An aliquot of the solution containing sulphide, sulphite and thiosulphate of sodium is added to a stoppered flask containing a known excess of chloramine-T (0.1 N) in 2 N sulphuric acid and shaken for about 5 minutes to effect complete oxidation of the sulphur compounds. The excess of chloramine-T is then estimated by the addition of potassium iodide and titrating the liberated iodine against standard thiosulphate solution.³ Thus, the quantity of chloramine-T consumed for the oxidation of sulphur compounds is determined (x).

To another aliquot, a freshly prepared alkaline cadmium hydroxide suspension is added to precipitate the sulphide as cadmium sulphide. The precipitate, after filtration and washing, is oxidised in an acid medium by chloramine-T and the amount of oxidant consumed is determined as described above (y). The filtrate from the above precipitate containing both sulphite and thiosulphate is acidified and treated with a solution containing a known excess of iodine. The sulphite is oxidised to sulphate and thiosulphate is converted into tetrathionate quantitatively. The excess of iodine is titrated against thiosulphate and the amount of iodine required

for such a reaction is easily obtained. The corresponding quantity of chloramine-T is readily calculated (z).

From the above data, it can be shown that if a, b and c are the number of moles of sulphide, sulphite and thiosulphate that are present in the mixture, then

$$8a + 2b + 8c = x; 8a = y; \text{ and } 2b + c = z$$

from which the values of a, b and c can be calculated. The results of a few representative estimations are given in Table I.

TABLE I

Analysis of the mixture of sulphide, sulphite and thiosulphate solution

| Component | Quantity taken* | Quantity estimated | | | |
|--------------|-----------------|----------------------------|-------|---------------------|-------|
| | | Kurtenacker-Wollack method | Error | Chloramine-T method | Error |
| Sulphide | 12.56 | 12.22 | -2.8 | 12.48 | -0.6 |
| | 5.74 | 5.68 | -1.0 | 5.71 | -0.5 |
| | 1.38 | 1.31 | -5.1 | 1.36 | -1.4 |
| Sulphite | 14.84 | 14.76 | -0.4 | 14.79 | -0.3 |
| | 4.95 | 4.89 | -1.2 | 4.92 | -0.6 |
| | 1.27 | 1.25 | -1.4 | 1.28 | +0.8 |
| Thiosulphate | 49.58 | 48.96 | -1.2 | 49.39 | -0.4 |
| | 15.36 | 14.96 | -2.6 | 15.26 | -0.6 |
| | 4.54 | 4.32 | -2.6 | 4.50 | -0.9 |

* Quantities of sulphur compound taken are expressed in terms of mg. of sulphur.

It can be readily seen from Table I that the present method gives more accurate results than the earlier one. Using N/100 chloramine-T and a standard solution of thiosulphate, it is possible to analyse very dilute solutions of a mixture of sulphide, sulphite and thiosulphate.

The author wishes to express his grateful thanks to Prof. K. R. Krishnaswami and Dr. M. R. A. Rao for their kind interest in the work.

Dept. of Gen. Chem., A. R. VASUDEVA MURTHY,
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Bangalore-3,
September 21, 1953.

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RIBOFLAVINE AND THIAMINE
CONTENTS OF GUMS

GUMS are valuable commercial commodities which have found very varied industrial and medicinal uses. They are believed to be astringent and anti-dysenteric; expectorant; tonic to the liver and known to enrich blood. Gum 'Babul' or the gum from *Acacia arabica* Willd. is particularly administered during pregnancy in the Konkan and Maharashtra in the form of a strengthening sweetmeat, mixed with sugar.¹ It was this latter use which suggested an analysis of some gums procured locally for their riboflavine and thiamine contents. A similar analysis of saffron which had yielded promising results has been reported elsewhere.²

Twelve gum samples were analysed for the presence of riboflavine and thiamine by use of the fluorimeter. An acetic acid buffer (pH 4.5) extract of gum to which papain and taka-diastase were added was taken. After allowing hydrolysis to proceed for 18 hours at 42° C., the enzymes were destroyed by heating the extract. The latter was filtered and an aliquot adjusted to pH 3.7 was treated with 4 per cent. potassium permanganate and hydrogen peroxide in order to destroy the pigment in the extract. The fluorescence of the filtrate thus obtained was read on a fluorimeter. A correction for fluorescent substances other than riboflavine was made in each case by adding a little sodium hydrosulphite to the extract and reading the fluorescence again.

Another aliquot of the acetic acid buffer extract was treated with alkaline potassium

ferrocyanide and isobutyl alcohol whereby the thiamine was oxidised to thiochrome³ and was estimated in the isobutyl alcohol layer by use of the fluorimeter.

The results of the analysis are presented in Table I.

It will be noticed that the gums analysed are very rich in riboflavine, particularly samples 1, 5, 6 and 9. These are edible and important medicinally. Thiamine was found to be present in samples 1, 5, 6 and 8, the richest sample being that of 'Semala' gum.

The authors thank Messrs. Hortus Indicus and Messrs. Kala Gandhi for supplying the gum samples and are grateful to Dr. H. R. Pithawalla and Mr. S. B. Dhungat of the University Department of Chemical Technology, Bombay, for their assistance in taking the readings.

St. Xavier's College,
Dept. of Microbiology,
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PSEUDOBANCH IN *MASTACEMBELUS*

So far as the author is aware, pseudobanch has not yet been described in the family Mastacembelidae. Day¹ describes the absence of pseudobanch as a diagnostic character of the family Mastacembelidae and Boulenger² also mentions its absence in the family. Job³ has also not made any reference to pseudobanch in *Mastacembelus*. During the course of studies on *Mastacembelus armatus* and *M. pancalus*, however, it was found that the pseudobanch is present in both the species. The observations are based on a study of the structure in the embryo as well as in the adult.

The pseudobanch is well developed in embryos over 10 mm. in length. In a typical transverse section of the embryo of *M. armatus* 21.6 mm. in length, the pseudobanch is seen as a large and prominent structure which projects into the oral chamber from the inner margin of the hyoid arch near its upper end (Fig. 1). Due to this, a narrow inpushing of the oral chamber is formed between the upper edge of the pseudobanch and the lateral border of the roof of the oral chamber which may be called

TABLE I

| Sample | Trade name of gum | Source | Riboflavine γ/g. | Thiamine γ/g. |
|--------|-------------------|-----------------------------------|---------------------|------------------|
| 1 | Babul | <i>Acacia arabica</i> Willd. | 79.6 | 8.42 |
| 2 | Ghatti | <i>Anogeissus latifolia</i> Wall. | 68.92 | 0 |
| 3 | Karai* | <i>Sterculia urens</i> Roxb. | 17.4 | 0 |
| 4 | Karai* | " | 31.0 | 0 |
| 5 | Palas | <i>Butea monosperma</i> Kuntze | 138.8 | 4.28 |
| 6 | Semala | <i>Bombax ceiba</i> Linn. | 178.6 | 24.28 |
| 7 | African | <i>Acacia</i> sp. | 53.2 | 0 |
| 8 | Swakin | " | 54.2 | 11.42 |
| 9 | Talu | " | 78.6 | 0 |
| 10 | Maklai | " | 60.2 | 0 |
| 11 | Gelatin powder | " | 60.2 | 0 |
| 12 | Arabic | <i>Acacia</i> sp. | 46.6 | 0 |

*Two different sources.

as suprapseudobranchial chamber. The epithelial lining of this chamber consists of greatly flattened cells, and the capillaries of the pseudobranch approach close to these cells; at other places the capillaries do not lie close to the lining of the oral chamber but are separated

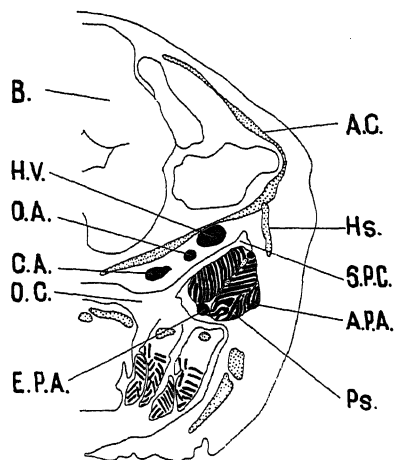


FIG. 1. T. S. Embryo of *Mastacembelus armatus* (21.6 mm. in length) passing through the region of pseudobranch.

A.C., auditory capsule; A.P.A., afferent pseudobranchial artery; B., brain; C.A., carotid artery; E.P.A., efferent pseudobranchial artery; Hs., hyosymplectic cartilage; H.V., head vein; O.A., orbital artery; O.C., oral chamber; Ps., pseudobranch; S.P.C., supra pseudobranchial chamber.

from it by the normal epithelial cells and connective tissues. In the pseudobranch there are no free branchial lamellae like that of a functional gill, but the entire organ presents a compact structure traversed by numerous capillaries, through which the blood from the afferent pseudobranchial artery passes into the efferent pseudobranchial artery. The orbital artery emerging from the carotid runs forward upto the anterior end of the pseudobranch where it gives a hyoidean artery and then continues as the afferent artery of the pseudobranch. The efferent artery from the pseudobranch runs forward upto the posterior margin of the eye where medially it is joined by a short branch with the fellow of the opposite side; it then passes round the external carotid and runs as the ophthalmica magna artery to the choroid gland of the eye. The structure described is pseudobranch, because it receives aerated blood from the carotid artery. The pseudobranch is supplied by a branch of the ninth cranial nerve, and this shows that the structure is a hyoidean pseudo-branch and not a spiracular one.

In the adult fish, in front of the first branchial arch, the roof of the oral chamber shows a small depression on either side near its lateral border. This represents the opening of a small chamber which has been described before as present in the embryo. On slitting open this chamber and removing the lining of the oral chamber lateral to the depression, the pseudobranch is seen as a small oval structure. In fresh condition it is visible as a reddish spot even through the lining of the oral chamber, but the colour is lost in preserved specimens.

Thus a pseudobranch is present even in the adult *Mastacembelus* though it is proportionately much reduced in size than in the embryo. In an adult *M. armatus* measuring about $1\frac{1}{2}'$ in length, the structure is about 3 mm. in length. In transverse sections, the pseudobranch shows a structure closely resembling that of the embryo and consists of a mass of blood capillaries resembling a *rete mirabile*. The pseudobranch was so far not recorded in adult probably because it is hidden below the buccal epithelium and is colourless in preserved specimens.

The suborder, Opisthomi, includes only a single family Mastacembelidae and this is probably derived from the family Blenniidae. This affinity is further supported by the presence of pseudobranch in the genus *Mastacembelus*. Further work will probably show that similar pseudobranch is present in *Rhynchobdella* which is the only other genus included in the family Mastacembelidae.

The author offers his sincere thanks to Dr. D. S. Srivastava for his kind guidance and interest in the work.

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Sagar, M.P., June 27, 1953.

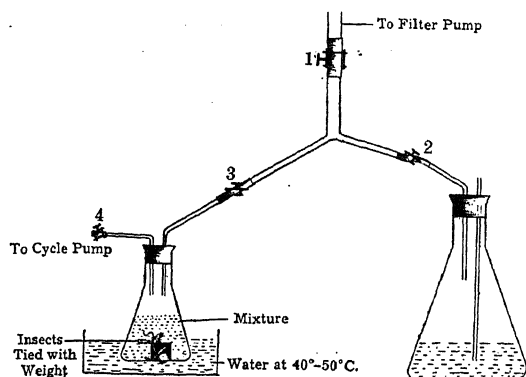
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A NOTE ON THE STUDY OF INSECT TRACHEAL SYSTEM

STUDENTS of insect morphology are well acquainted with the difficulties encountered in a detailed study of the tracheal system. Several methods have been tried to make the tracheal branches easily perceivable. Harshberger^{1,2} injected the living insects with intra-vitam stains, Hagmann³ used aqueous stains under low pressure created by a vacuum pump. Both these were tried by us but the results were not upto

the mark. We found Krogh's⁴ method with some modification more successful. But Krogh did not mention the proportions of the constituents used by him. Various proportions were, therefore, experimented upon by us, and the one mentioned below gave the best result.



Oil of Turpentine—1 part by vol.
Bee's wax (melted)—½ part by vol.
Paraffin wax (melted, m.p. 56-58° C.)—½ part by vol.

The mixture was coloured with red oil colour dye of I.C.I. instead of *alkanna* root which takes nearly a week and was also not available here. A pinch of the dye in 20-25 c.c. of turpentine gave a bright colouration. Then filtered bee's wax and paraffin were added to the mixture, which was well shaken and placed in the embedding bath for two hours. This mixture melts nearly at 41-43° C., and gives satisfactory results even without addition of colophonium.

The writers agree with Krogh that water and watery mixture are not very effective in penetrating the trachea.

The solidified mixture was placed in a small flask (250 c.c.) and a number of narcotized small insects were put into the flask tied by means of a thread to a small weight, so as to prevent them from floating on the surface of the liquid. The apparatus as detailed in figure above was connected with an ordinary filter-pump. The flask was then evacuated of air for 10-20 minutes after which it was immersed in hot water at a temperature of 40-50° C. and the evacuation continued for another 5-10 minutes. By this time the mixture melted causing the insects to float submerged. Then stopper No. 1 was closed and stopper No. 2 opened slowly to admit air into the flask. This was done in several instalments so as to ensure better penetration of the liquid. On reaching equilibrium, the pressure inside the experimental flask was increased by pumping air through a cycle pump

and valve, and a high pressure was maintained for 5-8 minutes. After this the material was taken out and immediately transferred to cold water. Krogh did not increase the pressure inside the experimental flask after the equilibrium was restored. But the authors found that increasing the pressure helped in a better penetration of the mixture into the finer tracheal branches. The excess of the mixture sticking on the surface was removed with a brush dipped either in xylol or ether. The whole tracheal system of the treated insects, including its branches was permeated by the mixture and was coloured red, and could be studied with comparative ease under a binocular microscope. If required these specimens can be preserved in formalin or 70 per cent. alcohol.

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University of Allahabad, AMAR N. CHATTORAJ.
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SEX CHANGES IN A WOOD-BORING BIVALVE MOLLUSC, *MARTESIA* *STRIATA* LINN.

THE phenomenon of sex-reversal has been reported in some of the wood-boring molluscs such as *Bankia*,¹ *Teredo*² and *Xylophaga*.³ Coe⁴ has recently given an excellent review on the subject. While investigating the biology and systematics of the wood-boring organisms in the Visakhapatnam harbour we examined the gonads of 130 specimens of the common local wood-boring bivalve, *Martesia striata* belonging to various size groups. The greatest antero-posterior length of the shell of each individual was measured and the condition of gonad ascertained. The results are tabulated below:

| Size | Total No. examined | Males | Hermaphrodites | Females |
|----------|--------------------|-------|----------------|---------|
| 1-10 mm. | 16 | 15 | .. | 1 |
| 10-15 " | 27 | 6 | 5 | 16 |
| 15-25 " | 80 | 12 | 30 | 38 |
| 25-30 " | 22 | 5 | 7 | 10 |
| 30-35 " | 14 | 4 | 2 | 8 |

It will be seen that of the 16 forms not exceeding 10 mm. in length, all were males with the exception of one female. In the size group

between 10-15 mm. five hermaphrodite specimens were found indicating a change of sex from male to female. It was noticed that in this size group the gonad contained more of spermatozoa and only a few ripe or unripe eggs. In the third size group between 15-25 mm. typical hermaphrodites were observed in which both the spermatozoa and ripe ova are well represented. In the fourth size group between 25 and 30 mm. the hermaphrodite forms are still represented, but the females are more in number than the males. The same condition was observed in the last size group where males and females were in the ratio of 1:2.

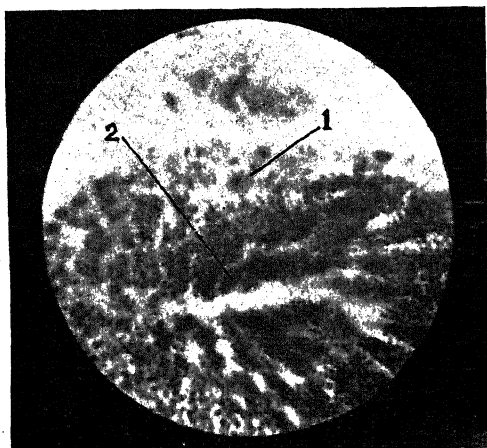


FIG. 1. Photomicrograph of T.S. of gonad of a hermaphrodite *Martesia striata*. 1. Egg, 2. Sperms.

From the above data it appears that *Martesia striata* is a protandric hermaphrodite,⁵ the young specimens being males, and the change to female taking place when the animal attains a length of about 15 mm. This change may apparently be delayed in some cases and, therefore, animals of medium length showed all the three sexes. It is possible that individuals may undergo more than one change of sex, so that the largest size group may consist of individuals which are females for the second time. Examination of sections of gonads of specimens belonging to various size groups confirmed these observations.

We have also examined the gonads of several specimens belonging to various size groups of *Teredo navalis* and *Teredo digensis* and are in a position to confirm the finding of Coe² and Grave⁶ regarding the sex reversal in this genus.

Fuller details will be given in a comprehensive paper under preparation.

Dept. of Zoology,
Andhra University,
Waltair, August 25, 1953.

P. N. GANAPATI.
R. NAGABHUSHANAM.

1. Sigerfoos, S. P., *Bull. U.S. Bur. Fish.*, 1908, 27
193. 2. Coe, W. R., *Bio. Bull.*, 1933, 65 (2), 283. 3. Purchan, R. D., *J.M.B.A.*, 1941, 25 (1), 1. 4. Coe, W. R., *Quart. Rev. Biol.*, 1943, p. 18. 5. Yonge, C. M., *Quart. Jour. Micro. Sc.*, 1926, p. 391. 6. Grave, B. H., *Bio. Bull.*, 1942, 82, 32.

INVESTIGATION OF RIBO AND DESOXYRIBONUCLEIC ACID IN CYANOPHYCEAE

GARDNER¹ AND SPEARING² have contributed a great deal of factual and descriptive knowledge of cytological phenomena in this group. But the chemical nature of the central body is yet to be found out.

Various staining methods were tried to determine the exact nature of the central body in this Group (e.g., crystal violet, hæmatoxylin, siemsaegalie, thionin, acetocarmine, aceto-orcein, acetolacmoid, etc.). With crystal violet and hæmatoxylin a well differentiated central body was noticed in almost all the species tried for.² Different samples of basic fuchsin (Grubler, Harleco, Gurr) were also tried, but no promising results have yet been achieved. The slight colouration of the central body by feulgen is however noteworthy.

The differential staining of RNA and DNA by an aqueous mixture of methyl green and pyronin at a suitable pH is well known (Brachet,³ Kurnick,⁴ Chayen,⁵ Sarma and Bhattacharjee⁶). The standard method, described by Darlington and LaCour,⁷ with variation in fixation and staining has been tried. Different fixatives (e.g., Carnoy's fluid, acetic alcohol, osmic acid, Serra's solution, Nawaschin solution, etc.), have been used to see the deviations. Some slides are stained after hydrolysis in N HCl at 60° C. for varying periods (experimentals). The proportions of methyl green pyronin in staining solution was increased from 3:7 to 7:3 gradually.

The central body does not take methyl green stain at all in any of the experimentals and controls tried. In the controls the cytoplasm is also stained; the cytoplasm is less stained after 5 minutes' hydrolysis. After 10 minutes hydrolysis the cytoplasm is almost clear but the central body retains the purple colour. As the timing of hydrolysis is increased, the intensity of the stain decreases. After 30 minutes hydrolysis the stain in the central body becomes very much faint. Similar was the result when

0.25 M. trichloro-acetic acid was used for hydrolysis at 65°C. showing that it is as effective in bringing about the same kind of changes within the cell. With different fixatives only a deviation in the colouration of the central body from purple to reddish violet was obtained. The purple colouration, developed in the central body with the above stain technique even after hydrolysis indicates the presence of RNA type. A similar result was reported by Hoffman⁸ with Fuso-bacteria.

When only pyronin (G) is used the central body takes an intense purple colour within 5 minutes. With purified methyl green (Merck) the cell takes bluish colouration and the central body is differentiated by slightly deeper but uniform staining. After staining in methyl green overnight, if the slides are kept in pyronin for 5 minutes, the central body takes the purple colouration. The differentiation in buffer solutions and 95 per cent. alcohol overnight, does not restore the previous bluish colouration of the central body. Chayen's method⁵ was followed to see whether the methyl green colouration is overlapped by pyronin due to sheer competition, but the restoration of the bluish colouration after differentiation has not been obtained.

0.5 per cent. methyl green and pyronin solutions in 0.2 M. acetate buffer (pH 4.28) were used in this case. Mostly the work was done on *Oscillatoria* and *Calothrix* species.

From the above experiments it is noted that the central body has a greater affinity for pyronin stain. This indicates the presence of RNA or DNA in less polymerised condition. It is quite likely that DNA has not been highly polymerised in this lower group.

For further clarification in this matter the constituents of the nucleic acids should be sought for, which is now in progress.

I express my deep gratitude to Professor Y. Bharadwaja for his guidance and criticism and to Dr. R. N. Singh for his suggestions and advice.

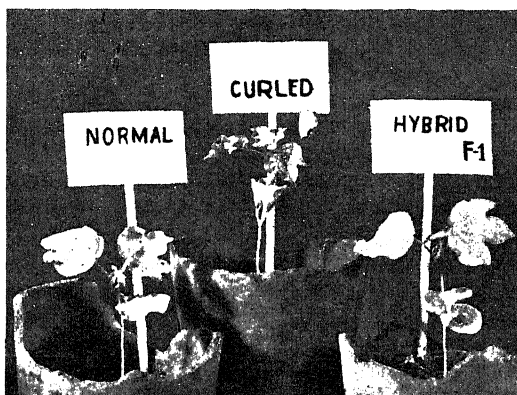
Dept. of Botany,
Banaras Hindu University,
Banaras-5, June 23, 1953.

B. B. BISWAS.

1. Gardner, N. L., *Univ. Calif. Publ. Bot.*, 1906, **2**, 237.
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A CURLED-LEAF MUTANT IN HERBACEUM COTTON

A PLANT with its leaves curled upwards and inwards was observed as a solitary variant in a yield trial plot of the 2087 variety of herbaceum cotton in the 1951 season at the Agricultural Research Station, Surat. Strain 2087 is derived from the backcross (1027-A.L.F. × Vijay) Vijay. The new plant (see Fig. 1) resembled its sister-plants in other morphological characters. While it bred true to type, its crosses with normal-looking sister-plants gave fully normal F_1 plants. In the F_2 there was a monogenic segregation of 1073 normal: 352 curled ($X^2 = 0.07$), indicating that the abnormality was due to a recessive gene. The curly character of the leaves appears to be the result of a mutation as no such plant had been maintained or observed at this Station.



A similar curled leaf-plant was found in the 1027-A.L.F. (herbaceum) variety, in the 1952 season, by a colleague (Shri N. D. Desai). A cross between the two curled leaf mutants resulted in curled-leaf plants indicating the identity of the locus at which the mutation occurred in the two varieties.

Chi Pao Yu² reported a similar mutation, Curly Leaf, Cu, in the Asiatic (arboreum) cotton variety "Small White Flower". The plants under discussion resembled Yu's mutant in characters of leaves except that the leaves were dimpled (not smooth). However, the reduction reported by him in the size of flowers, bolls and seeds and in germination capacity was absent. An additional character observed was the distinctly finer feel of their lint.

Microscopic examination revealed that the palisade cells in the curled leaf were narrower and more densely packed and also contained more chloroplasts. The lint fibres were appreciably thinner. Very probably, the thinness of

fibres, which were found to be equally mature in technological tests as those from normal plants, is responsible for the finer feel of lint, as reported by Nanjundayya.¹

The identity of the locus of the present mutation with Cu, is being tested by studying its linkage relationships.

Our thanks are due to Shri M. U. Parmar for technological tests of fibre maturity.

Agri. Res. Station,
Surat, July 1, 1953.

N. R. BHAT.
K. D. KHATTAR.

1. Nanjundayya, C., *I.C.C.C. Tech. Bull., Series B*, No. 36. 2. Yu, Chi Pao, *J. Genet.*, 39, 69.

A TRICHODERMA DISEASE OF HONEY BEES

SOME dead bees were collected from an apiary near Jorhat in July 1952. The owner complained that all of a sudden the large number of his bees died while the rest had fled away. The dead bees collected were examined with a hand lens which revealed the presence of fungal growth covering the bodies of the dead bees. Such bees when dissected and examined carefully under the microscope showed that the walls of the stomach were riddled with fungal growth and in badly infested ones, the tissues were completely disintegrated.

A large number of isolations was made and a species of *Trichoderma* was always obtained in culture. It was identified as *T. lignorum* (Tode) Harz.

Inoculation experiments were carried out on bees kept in cages with the pure culture of the fungus. Spores of the fungus were either mixed with sterile water and then sprayed on the bodies of the bees with an atomizer, or were mixed with their food (dilute sugar solution) and the bees allowed to feed on it. In both cases infection took place and the bees developed a disease and ultimately died.

The first symptoms of infection were weakening, restlessness and continued effort on the part of the bees to escape. Later, the affected bees started crawling, lost one or more legs. The first crawlers appeared in 1-3 days depending upon the virulence, rate of growth of the fungus and the quantity of inoculum used. Death occurred within a few hours after the commencement of crawling.

So far, no such disease of honey bees appears to have been reported from any part of India. Fielitz¹ from Germany and Nicolls² from Tasmania, however, have reported diseases of bees caused by species of *Trichoderma* and other fungi.

Further studies are in progress and a detailed report will appear elsewhere.

Mycologist, S. CHOWDHURY.
Jorhat, Assam, July 13, 1953.

1. Fielitz, H., *Centbl. Bakt.*, 1925-26, 66, 28. 2. Nicolls, H. M., *Tasmania J. Agric.*, 1934, 5, 13.

INHERITANCE OF LOBED LEAF MARGIN IN MUNG (*PHASEOLUS AUREUS* L.)

THE Mung leaves are trifoliate with long petioles. Generally the leaflets have entire margin, but rarely types with tri-lobed leaflets are also met with. In Uttar Pradesh types with lobed leaf-margin are not found at all.

In crosses between a lobed leaf type, 41 D-I, and other types with entire leaf-margin, viz., T1, T48-6 and T49-8, the lobed leaf character has been found to be dominant in F_1 . In F_2 the results shown in Table I were obtained:

TABLE I

| Cross | No. of plants with lobed leaf margin | No. of plants with entire leaf margin | Total No. of plants | Chi-square (3:1) | P Value |
|------------|--------------------------------------|---------------------------------------|---------------------|------------------|--------------|
| 41D-IXT.1 | 343 | 99 | 442 | 1.5958 | 0.20 to 0.30 |
| 41D-IX48-6 | 412 | 138 | 550 | 0.0024 | 0.95 to 0.98 |
| 41D-IX49-8 | 266 | 109 | 375 | 1.9003 | 0.20 to 0.30 |

The above data give a good fit to a 3:1 ratio as the chi-square value is not significant. Thus the two characters, viz., lobed vs. entire leaf-margin are controlled by one major gene difference.

The above finding is further substantiated by the F_3 data. Out of 21 lobed leaf type F_2 individuals grown in F_3 , 7 bred true for the lobed leaf type character and the other 14 individuals segregated into lobed and entire leaf-margin plants in a 3:1 ratio. Six F_2 individuals with entire leaf-margin were also grown in F_3 . All these individuals bred true for the entire leaf-margin character.

From the above data it is concluded that "lobed leaf-margin" is dominant over "entire leaf-margin" with a monogenic difference. The 'entire leaf-margin' is designated by the symbol 'e' and the 'lobed leaf-margin' as 'E'.

Govt. Res. Farm,
Kanpur, U.P.,

DHARAMPAL SINGH.
T. R. MEHTA.

September 8, 1953.

REVIEWS

Encyclopedia of Chemical Technology, Vol. IX.

By R. E. Kirk and D. F. Othmer. (Interscience Publishers, New York), 1952. Pp. xvii + 943. Subscription Price \$25 per copy. Single copy \$30.

"Kirk and Othmer" has now become a familiar name to all students and research workers in chemistry, pure and applied, more particularly the latter. The previous volumes in the series have been very well received and appreciated. The present Volume No. 9, keeps up the standard expected. It covers the alphabetised subjects ranging from "Metal surface treatment" to "Penicillin". As in previous volumes, it is authored by mostly American scientists drawn from the leading Universities and research institutions as well as from well known and reputed industrial organisations such as The American Cyanamide Co. (Nitro benzene and nitro toluene), Blaw Knox Construction Co. (Oxo and oxyl processes), Squibb Institute of Medical Research (Penicillin), General Aniline and Film Corp. (Nitroso dyes, etc.), John's Manville Research Centre (Mineral Wool), International Nickel Co. (Nickel and nickel alloys), Bell Telephone Laboratories (Metal surface treatment), West Virginia Pulp and Paper Co. (Paper coatings), Commercial Solvents Corporation (Nitro alcohols), Du Pont De Neumois Co. (Nitro paraffins), Monsanto Chemical Co. (Packages and packaging), Rohm and Hass (Methyl amines), Hoffman La Roche (Pantothenic acid, etc.). The experiences of the University and research men and the practical wisdom of those engaged in the leading industries give the articles an authority that creates confidence in their contents and presentation. Many articles, depending on the nature of the subject, get a coverage of nearly 30 pages and are suitably illustrated with well printed diagrams.

An interesting aspect of "Kirk and Othmer" is that the pure science subjects are as well thoroughly covered as the applied science subjects, so that one is tempted to ask whether these volumes should not be styled as "Encyclopedia of Science and Technology". There are practically no errors to be detected in this volume. One is however amused to read in a volume printed in 1952, that Mysore and Coorg are in British East Indies (p. 589). This only shows that in spite of the world becoming

"smaller" there are limitations to our knowledge of geography.

There is no doubt that "Kirk and Othmer" is a 'must' for the industrial, University and public libraries in spite of its rather heavy cost.

M. A. G. RAU.

Encyclopedia of Chemical Technology, Vol. X.

Pentacene to Polymethine Dyes. Edited by R. E. Kirk and D. F. Othmer. (Interscience Publishers, Inc.), 1953. Pp. 976. Price \$25.00.

As stated by the publishers, the Kirk-Othmer Encyclopedia presents a comprehensive summary of industrial knowledge on materials, methods, processes, and equipment for the chemist and the chemical engineer. This claim is fully justified and generally recognized; Kirk-Othmer has therefore become a necessary addition to the library of institutions concerned with any branch of chemical technology. The emphasis throughout is on commercial, practical and technological aspects. The chemical treatment is somewhat elementary, in comparison for instance with Thorpe's Dictionary.

The present volume maintains the standard of its predecessors. The articles on various topics have been written by experts chosen largely from American industry, and have obviously been submitted to careful editorial co-ordination, since there is much more uniformity than in Thorpe's Dictionary concerning the scope, presentation and readability. The articles on Phthalic Acids, which contains the interesting prophecy that isophthalic acid will grow to exceed phthalic anhydride in production volume and be lower than it in price, and those on Pilot Plant, Plant Location, Photography and Photochemistry are typical of the high quality of the Kirk-Othmer Encyclopedia and of its great value to every chemist.

A few minor omissions may be noted. In the article on pigments (organic) there is no reference to the important paper of Glassman in the *J. of the Oil and Color Chemists Association* (1950, **33**, 191). The article on Phthalocyanine Dyes does not mention recent developments in their application to textiles, such as Alcian Blue, Indanthrene Brilliant Blue 4G and Phthalogen Blue IF3G. In the article on phloroglucinol "trihydrazone" should read as "trioxime".

The article on Polymethine Dyes, written by two members of the Kodak Research Laboratories, is excellent within the limits of the space allotted to it, but it is regrettable that the editors could not be persuaded to provide at least five times this space, considering the scientific and technical interest of the polymethines.

K. V.

Colliery Surveying. By R. McAdam. (Oliver & Boyd), 1953. Pp. vii + 145. Price 12 sh. 6d.

This text-book on Colliery Surveying has been prepared to meet the requirements of students studying for the Colliery Managers and Undermanagers' Certificates of Competency and the new National Certificates in Mining.

The work includes levelling, chain and compass traversing, the use of simple vernier theodolites and mining problems on areas and volumes and structural geology of carboniferous strata.

The construction and use of the various instruments involved in mine surveying has been clearly described and illustrated. The last chapter on theodolite surveying deals with the problems connected with the use of mining theodolites and the correlation of surface and underground surveys in a concise manner. A large number of review questions and answers from former Statutory Examination Papers have been appended to each chapter enabling the student to become familiar with the types of questions set at these examinations.

Altogether the scheme of the work is so arranged that it gives a systematic drilling in the proper use of surveying instruments and methods of underground surveying that any student can easily rely on himself to learn the basic principles of colliery surveying without any difficulty.

The text is illustrated with simple line diagrams and explanatory numerical examples throughout, and also contains useful tables of areas, volumes and other data at the end.

P. MURUGA MANICKAM.

The Atomisation of Liquid Fuels. By E. Giffen and A. Muraszew. (Chapman & Hall, Ltd.), 1953. Pp. ix + 246. Price 36 sh. net.

This book meets a real and long-felt need and gives an excellent account of the results of the work of a large number of investigators including that done by the authors. The balance is very well kept between fundamental conceptions and their application in practice, theoretical approaches and experimental technique.

The chapter on the use of dimensional analysis will be appreciated by many readers.

The subject of the book is well introduced in the first chapters dealing with the mechanism of spray disintegration. The explanations and especially the numerical examples acquaint the uninitiated reader with the principles involved. Besides providing an account of fuel spray characteristics and the effect of the particulars and design of the atomiser thereon. The theoretical treatment of the swirl atomiser as example, in the next chapter, is noteworthy. The next chapters—after the interlude on Dimensional Analysis—are devoted to the study on effects of the characteristics of the liquid and of the gaseous medium in which the spray develops, on its details such as droplet size, penetration, cone angle, etc. The effects of air movements will be interesting for the diesel engine designer. After a chapter on the essential distinguishing features of intermittent and continuous sprays, the book concludes with a survey on experimental methods applied in the field, which is very welcome inasmuch as it contains hitherto widespread and scarcely available information.

Naturally, the book is essentially concerned with high pressure atomisation. However, it would be interesting to have the authors' views on low pressure, if not air, injection, and some account of possible techniques, which may have embraced even details of carburetion of light volatile fuels.

The book maintains a high standard throughout and provides information not to be found elsewhere in easily comprehensible and accessible form.

H. A. HAVEMANN.

Nutrition in India. By V. N. Patwardhan. (*The Indian Journal of Medical Sciences*, Bombay 4), 1952. Pp. viii + 345. Price Rs. 10.

Though nutrition research has been carried out in different institutions in India during the last 40 years, only the investigations of a few people like McCarrison, McCay and Aykroyd are well known to nutrition workers throughout the world. There is, however, a good deal of information on nutrition in India, which exists either in Government reports or in Indian scientific publications which had only limited circulation in the past. The result has therefore been that quite a number of important observations of interest to nutrition workers everywhere have so far not received the recognition they deserve.

In the book under review, Dr. Patwardhan has accomplished the commendable task of

gathering most of the available material and in 23 different chapters has practically summarised the progress achieved in the field of nutrition research in India. After giving an account of the investigations carried out on common Indian foodstuffs and their peculiar methods of preparation in various parts of India, Dr. Patwardhan has devoted special attention to rice, wheat and other cereals, pulses, milk, etc., in separate chapters. Investigations carried out on vitamins and minerals have also been separately dealt with. There is a special chapter on basal metabolism followed by a detailed account of nutritional diseases in India and other diseases directly or indirectly associated with dietary habits. The concluding chapters contain an account of the nutrition work carried out in the different States and a discussion of the problem of population and food supplies in India.

This book, as rightly stressed by the author in his preface, is not meant for students but is mainly intended for research workers in India and abroad, so that they may obtain access to some valuable publications from India. In view of this, it is felt that undue prominence has been given to unpublished data in some places in the book. Also, the author could have maintained an objective approach, instead of giving expression to strong personal views on different aspects of nutritional work carried out in India. Further, in view of recent developments, tryptophane-nicotonic acid interrelationship could have been more adequately dealt with particularly in relation to the aetiology of pellagra. These criticisms apart, there is no denying the fact that the book under review, well illustrated by a number of diagrams and photographs, is a mine of information whether one seeks it from the point of view of Indian foodstuffs, or Indian dietary habits or the incidence and aetiology of nutritional diseases in India. The get-up of the book is very pleasing and far superior to many others published in this country.

P. S. SARMA.

Mechanism of Corticosteroid Action in Disease Processes. (*Annals of the New York Academy of Sciences*, Vol. 56, Art. 4). Edited by Roy Waldo Miner. (Published by the Academy, New York), 1953. Pp. 623-814. Price \$3.50.

The title of the monograph indicates its objective, viz., to throw light on the mechanism of action of steroidal hormones from suprarenal cortex, in diseased processes. The application of the hormones in diseases, widely varying in nature, from infections to metabolic

disorders, has raised a veritable pharmacological conundrum. The aim of this monograph is an attempt to articulate facets in the jigsaw puzzle, to evolve, if possible, completed system of rational treatment with corticosteroids. The aim is bound to elude the grasp. But the diverse aspects studied and reported in this monograph, like the influence of adrenal cortex on vascular bed, relationship of potassium in regulation of blood pressure in corticosteroid hypertension, oxygen consumption and electrical activity in relation to adrenal cortex, influence of cortisone on granulation tissue, connective tissue, ground substance, mast cells, salicylate therapy and several others, aim at getting light to elucidate the mode of action of corticosteroids. The study reveals that a more specific effect is involved in each case than could be accounted for by a general metabolic effect. Such a trend need not detract interest from further study.

While commending this laborious study for workers in this field, one would have preferred a summary at the end of each monograph or aspect of the subject, for the benefit of those who cannot rummage through each monograph. This number of the *Annals of New York Academy of Sciences* should find a place in any library catering to the study of biochemistry, pharmacology and medicine.

V. ISWARIAH.

Phylogeny and Morphogenesis (*Contemporary Aspects of Botanical Science*). By C. W. Wardlaw (Macmillan & Co., London), 1952. Pp. viii + 536. Price 42 sh. net.

Despite the extreme narrowness of specialisation in every field of science, there is to-day an urgent need for integrating the many branches of science in understanding even the chosen fields of specialisation of the individual scientist. Never before has there been so much written on teamwork among scientific workers than at the present time and judging from that point of view, Prof. Wardlaw's new book is of exemplary nature in that it summarises admirably the experimental aspects of genes and development, genetic constitution in relation to shape, size and differentiation, biochemistry of morphogenesis and histogenesis and lastly mathematical considerations in the study of these subjects together with an excellent chapter on experimental morphology.

The earliest chapters of the book deal largely with phyletic methods as exemplified by the Pteridophytes drawing freely from examples of extinct and living genera. These phylogenetic

studies of contemporary workers have been ably epitomized and rightly great prominence is given to the new orientation afforded by the pioneering work of Prof. Manton on the cytology of Pteridophytes. It is noteworthy that the classical work of Bower on the Ferns, which was undertaken at a time when this new experimental and cytogenetical facet of Pteridophyte study was not initiated, would have immensely benefitted by the many speculative writings on the evolutionary activity in that group if it were only possible to look in retrospect. This new field of Prof. Manton is worthy of commendation to Indian workers as the chromosome numbers of many a wild species of fern occurring amidst our numerous high altitude floras have remained for long a mute story. The composite nature of *Dryopteris* and *Thelypteris* showing widely differing ancestry and owing their resemblance to parallel evolution and the even more startling discovery that the ferns are a very varied assemblage and that the primitive *Ophioglossum* shows in one species *O. vulgatum* the highest chromosome number yet discovered in a wild species in the plant kingdom are subjects of immediate concern to Cytogeneticists.

Much can be written in praise of the many interesting chapters of this book which sound like the saga of living plants and its many faceted life processes. Biochemical morphogenesis and histogenesis are two chapters that need careful reading and assimilation. Experimental approach to many branches of botanical science has been stressed in recent years and the discovery of hormones and their influence on tissue culture and *in vivo* experimentation has opened up new avenues of fruitful investigations and these and related subjects are well presented. The book terminates with a chapter on 'Towards a synthesis', where much of the literature presented in preceding pages are summarised. Undoubtedly this book embodies much material indicative of a new approach to the fast advancing botanical science and has more than suggested many broad lines of investigation aiming at a convergence of the twin branches phylogeny and morphogenesis. I commend this well-written and excellently printed book for careful assimilation of the many new approaches made in recent years in a branch of science where orthodox approaches to plant taxonomy and phylogenetic classification have received a new orientation in the hands of the 'experimental botanist'.

T. S. SADASIVAN.

Name This Insect. By Erich Fitch Daglish. (J. M. Dent & Sons), 1952. Pp. xxvi + 294. Price 15 sh. net.

A handy, handsome volume of octavo size, bound in bright green cloth with the figure of a slender water-gnat in gold as the central motif on the front cover, rendered still more attractive by a cover flap bearing illustration in colour of various common insects, this publication may very well serve as a presentation book to friends with a bias for natural history.

The publication is intended to serve the needs of laymen in the British Isles who are interested in natural history, but have neither the time nor the patience to refer to learned volumes of insect classification to identify various common insects they may meet with in the course of a walk. The author has given simple keys for working out the names of insects, based on easily recognizable characters such as the peculiarities of shape and coloration of the head and snout, the feelers, the legs, the wings and other parts of the body. The keys are easy enough to enable the reader to find out the common name of the insect captured, and in many cases, also to get information on its life-history and habits. The reader may derive immense help in this task by a reference to the plentiful illustrations of common insects contained in the book, there being 16 colour plates containing figures of 85 different species, as well as 48 plates of black-and-white half-tone illustrations of 265 other species. There is little doubt that the book will be found useful and popular in the United Kingdom.

Outside the British Isles, however, it may not serve the same purpose, as in many cases the species of insects met with may be totally different, but all the same, the reader may be enabled to recognize the class of insects, to which they are allied.

One would rather wish that there were available in India, a book of this character, dealing with the common species of Indian insects, to enable the non-technical layman, as well as students interested in natural history, to recognize the common insects.

Considering the large number of excellent illustrations, especially the coloured ones, the advertised price of the book is modest enough.

Y. R. RAO.

Books Received

Annual Review of Biochemistry, Vol. 22. Edited by J. Murray Luck. (Annual Reviews Inc.). Pp. ix + 729. Price \$ 6.00.

- A Spectrophotometric Atlas of the Transition of OH.* (NBS Circular 541). Pp. 21. Price 20 cents.
- Animal Biochromes and Structural Colours.* By Denis L. Fox. (Cambridge University Press), 1953. Pp. xiii + 378. Price 60 sh. net.
- Mathematical Aspects of the Quantum Theory of Fields.* By K. O. Friedrichs. (Interscience Publishers). Pp. viii + 272. Price \$5.00.
- Geology of India*, 3rd Edition. By D. N. Wadia. (McMillan & Co.), 1953. Pp. xx + 531. Price 50 sh. net.
- Introduction to Dynamics.* By L. A. Pars (Cambridge University Press), 1953. Pp. xxii + 501. Price 31 sh. 6d. net.
- Manual of Indian Forest Botany.* By N. L. Bor. (Oxford University Press), 1953. Pp. xv + 441. Price Rs. 25.
- Biochemical Transformations of Starch and Cellulose.* Edited by R. T. Williams. (Biochemical Society Symposia No. 11, Cambridge University Press), 1953. Pp. 84. Price 10 sh. 6d. net.
- Organic Analysis*, Vol. I. By J. Mitchell, I. M. Kolthoff, E. S. Proskauer, A. Weissberger. (Interscience Publishers Inc.), Pp. viii + 473. Price \$8.50.
- Tables of Dielectric Constants and Electric Dipole Moments of Substances in the Gaseous State.* (United States Dept. of Commerce). NBC Circular 537, 1953. Pp. 29. Price 20 cents.
- Elements of Forest Economics.* By Sven Petrin. Translated by Mark L. Anderson. (Macmillan & Co.), 1953. Pp. viii + 210. Price 22 sh. 6d. net.
- Selected Values of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds.* (Carnegie Institute of Technology), 1953. Pp. ix + 1,050. Price \$7.00.
- The Birds of Burma.* By Bertram E. Smythies. (Revised Edition). (Macmillan & Co.), 1953. Pp. xiii + 668. Price £4 4 sh.
- Practical Chromatography.* By R. C. Brimley and F. C. Barrett. (Chapman & Hall), 1953. Pp. 128. Price 15 sh.

SCIENCE NOTES AND NEWS

The Delhi Pillar

The freedom from rusting of the famous iron pillar at Delhi has long been a subject of comment and has been attributed by many writers to the peculiar properties of the ancient iron from which it is forged. Although some particulars of its history are obscure, it seems certain that the pillar dates from about the fifth century A.D. and is roughly 1,500 years old. The immunity of iron from rusting over such a long period is a striking phenomenon. In this connection the results of some experiments reported by J. C. Hudson in *Nature* (1953, 172, 499) are of great interest.

Small specimens, 4" x 2", of steel ($\frac{1}{8}$ " thick) and zinc ($\frac{1}{20}$ " thick) were exposed in the open air near the pillar for 1 year and their losses in weight were then determined after the corrosion products had been removed. The corrosion-rates were compared with the results of similar tests made at other stations, both in England and overseas.

These make it clear that the corrosive conditions at Delhi are very mild. It is known from the classical researches of W. H. J. Vernon that the relative humidity of the air is the primary controlling factor for the atmospheric corrosion of iron and that little or no rusting occurs unless the humidity exceeds 70 per cent.

The meteorological data for Delhi show that this critical value would only be reached for a short time during the whole year. Presumably, too, the sulphur pollution of the atmosphere, which, as Vernon demonstrated, controls the corrosion rate when the humidity reaches the critical value for rusting, is but slight in the neighbourhood of the iron pillar.

Indeed, the zinc specimens were so little corroded that they retained much of their original polish after a year's exposure there. In Hudson's view, therefore, the lack of serious rusting of the pillar is to be attributed to the mildness of the local climate rather than to any intrinsic superiority in the corrosion resistance of the iron itself.

Flying Saucers

In an article in *Science* (1953, 118, 124), C. C. Wylie of the State University of Iowa describes his investigations on 'flying saucers' which have been much observed in the United States. Wylie concludes that these are simply reflected sunlight having the following characteristics: (1) they are seen only when the sun is shining; (2) they are generally in the part of the sky opposite the sun; (3) there is only one sighting on each area as the area for the critical angle is small.

Synthesis of Pituitary Hormone

The synthesis of oxytocin, a hormone from the important pituitary gland, has been announced by Dr. Vincent Du Vigneaud, Professor of Bio-Chemistry at the New York Hospital, Cornell Medical Centre, in a recent issue of the *Journal of the American Chemical Society*. Oxytocin is the first protein hormone to be synthesised and the first to have its exact chemical make-up determined.

International Union of Crystallography, 1954

The Third General Assembly and International Congress of the International Union of Crystallography will be held in Paris during July 21-28, 1954. At the Congress, papers will be presented on all aspects of crystallographic research; there will also be an exhibition of crystallographic apparatus and books. After the Congress two specialized symposia will be held on "The Location and Function of Hydrogen" and "The Mechanism of Phase Transitions in Crystals", and there will be visits to localities of mineralogical interest. Full details of the meeting may be obtained from the General Secretary of the Union (R. C. Evans, Crystallographic Laboratory, Cavendish Laboratory, Cambridge, England), or from the Secretary of the Programme Committee (A. J. Rose, Laboratoire de Mineralogie, 1 rue Victor Cousin, Paris 5, France). Offers of papers for the Congress and symposia and notice of enrolment must reach the Secretary of the Programme Committee (preferably on the form accompanying the first circular) by February 15, 1954. All general correspondence should also be addressed to the Secretary of the Programme Committee.

The Palaeobotanist

Volume 2 of the *Journal* has now been published (price Rs. 20). Volume I (Birbal Sahni Memorial Volume) is also available (price Rs. 50). The prices are inclusive of postage. Copies of the two volumes can be obtained on application from the Registrar, Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow (India).

Dr. S. Husain Zaheer

Dr. S. Hussain Zaheer, Director, Central Laboratories for Scientific and Industrial Research, Professor and Head of the Department of Chemical Technology, Osmania University, Hyderabad-Dn., has been nominated by the Institution of Chemists (India) to deliver

the H. K. Sen Memorial Lecture for the current year.

Progress Review in General Zoology

Material relating to *General Zoology* is invited from research workers for inclusion in the yearly review publication of the NIS entitled "Progress of Science in India" for the years 1951-53. They may be forwarded to Dr. B. S. Chauhan, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta 12, as and when published.

Essay Contest

The Indian Dairy Science Association has organised an essay contest open to all *bona fide* students of dairy, agricultural, veterinary and other educational institutions and research institutes. The subject of the essay is "Application of Refrigeration in Improving the Dairy Trade in India". The essay should be written in English, not exceeding 3,000 words, and three typed copies must be sent to the Association before 15th January 1954. Further particulars can be obtained from the Hon. Secretaries, Indian Dairy Science Association, Hosur Road, Bangalore-1.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Chemistry to Mr. G. Viswanath for his thesis entitled "Absorption Spectra of Certain Bicyclic Compounds and Disubstituted Benzenes" and the D.Sc. Degree in Pharmacology to Mr. V. Subba Rao for his thesis entitled "A Study of Some Indian Medicinal Plants".

The University of Bombay has awarded the Ph.D. Degree in Chemistry to Sri. N. H. Sivarama Krishnan for his thesis on "The Spreading Properties of Rubber and Rubber Derivatives".

The University of Poona has awarded the Ph.D. Degree in Biochemistry to Shri Madhav Vinayak Patwardhan for his thesis entitled "Experimental Liver Injuries".

Addendum

Vol. 22, No. 10, p. 293: Article on "The Importance of Mid- and Upper Tropospheric Thermal Systems.....during the Nor'wester Season": The following is to be added as a footnote at the end of Column 2:

N.B.—In Figures 1 to 4, the wind arrows with shafts as continuous lines denote thermal winds between 10,000 and 18,000 feet, while the arrows with shafts as broken lines denote thermal winds between 10,000 and 20,000 feet. Winds at 20,000 feet were used when 18,000 feet winds were not available.

Current Science

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THE ORIGIN OF THE COLOURS IN PRECIOUS OPAL*

1. INTRODUCTION

THE opal has been, since ancient times, one of the most admired of all gem-stones. It is certainly unique amongst them all in many respects. The description by the Roman writer Pliny of a famous opal is so graphic that it may be quoted here. "In it," he says, "you shall see the burning fire of the carbuncle, the glorious purple of the amethyst, the green sea of the emerald, all glittering together in an incredible mixture of light. Some opals by their refulgent splendour rival the colours of the painters; others the flame of burning sulphur or of fire quickened by oil". From this by no means over-enthusiastic word-picture, it is clear that no pictures in black and white could do justice to the beauty of the opal.

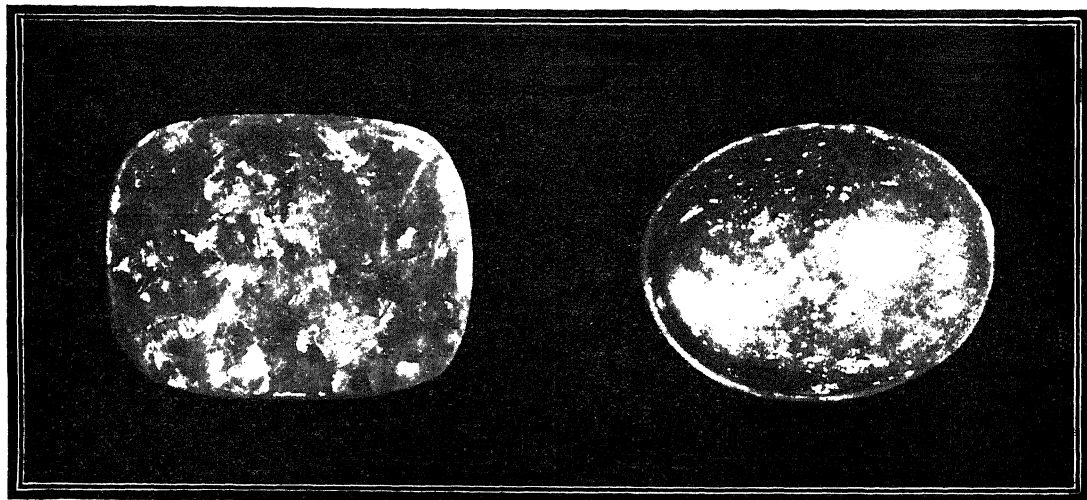
Nevertheless, we reproduce below enlarged photographs of the two finest specimens in the museum of my Institute. One is a flat tablet purchased from a jeweller in Bangalore and shows brilliant green and blue reflections with a few yellow patches. The characteristic lamellar structure of the gem-stone can be seen in places, though the magnification is inadequate to show it up properly. The water-opal pictured to the right presents an altogether different appearance. It is of rounded form, and though beautiful enough in broad daylight, is a most attractive object when viewed under a bright source of artificial light. Numerous little spangles of reflected light of varied colours sparkle here and there within its volume, shifting their positions as the specimen is turned round.

Explanations of the remarkable optical effects exhibited by precious opal have not been wanting. But we shall not recount them

* Presidential Address to the Indian Academy of Sciences at its 19th Annual Meeting held at Ahmedabad on 27th December 1953.

here, since they are conjectural and have no factual support. The problem has, however, at last been definitely solved. In recent papers by myself and Mr. Jayaraman published in the *Proceedings* of the Academy, experimental facts revealed by optical and X-ray investigations are set out which enable us to state in precise terms the nature of the structure which is responsible for the iridescence of precious opal.

India not far from Indore exhibit in association with agate a white porcelain-like material, examination of the X-ray diffraction pattern of which reveals it to be pure cristobalite in its low-temperature form, see Fig. 2 (a). On heating it to about 300° C., the material changes over to the high-temperature form of cristobalite with fewer lines in its X-ray pattern, see Fig. 2 (b). On cooling, it reverts again to the low-temperature form.



Gem-Opal

FIG. 1

Water-Opal

2. X-RAY STUDY OF OPAL

Any substance consisting predominantly of silica which has a density too low for its being identified with chalcedony and is "amorphous" in appearance is designated by mineralogists as opal. Materials which are different in their ultimate structure and even in their external appearance and physical properties are thereby lumped together under a common name, and as a consequence, there has been much confusion in the literature of the subject. A proper basis for the classification of siliceous materials is evidently to be found in their X-ray diffraction patterns. The study of the latter is accordingly the first step towards an understanding of the true nature of opal and the discovery of the origin of the colours which the precious varieties exhibit.

Well-developed crystals of the forms of silica known as tridymite and cristobalite are something of a rarity. It might, however, be anticipated that massive or cryptocrystalline forms of tridymite and cristobalite might be found to occur in nature rather more frequently. Indeed, specimens collected by me some years ago on the open terrain in Central

3. THE STRUCTURE OF HYALITE

Totally different from the naturally occurring cristobalite in its appearance and physical properties is the material known as hyalite or Muller's glass. It is a transparent solid, but examination of a specimen available in the museum of my Institute has revealed that the passage of a pencil of light through it results in the production of a well-defined diffraction halo with a hexagonal outline, thereby showing that the material is not optically homogeneous but has a stratified structure. Hyalite, in fact, appears to be the true prototype of iridescent or precious opal. X-ray examination reveals that the structure of hyalite is totally different from that of the naturally occurring cristobalite and exhibits certain characteristic features. The latter are to be found also in other materials resembling it in transparency, density and refractive index. The three X-ray diffraction patterns reproduced below as Fig. 3 (a), (b) and (c) are respectively those of a semi-transparent waxy opal, of hyalite itself, and of a "fire-opal" which is a gem-stone exhibiting a very pretty orange red colour. The water-

opals give X-ray patterns almost identical with those reproduced in Fig. 3.

A clue to the understanding of these patterns is to be found on a careful comparison of the same with the diffraction patterns reproduced in Fig. 2 (b) and (c) above which are respectively those of the high-temperature form of cristobalite and of tridymite at room temperature. While in their outer parts, the patterns are closely parallel to that of high-cristo-

in which they are traversed by the light. A variety of effects may be observed in different circumstances, examples of which are actually met with in the study of the optical behaviour of opals. As the spacing of the stratifications is progressively diminished, a stage is reached when the diffraction haloes or spectra observed in the forward or transverse directions disappear, and we have, instead, monochromatic reflections backwards towards the source of

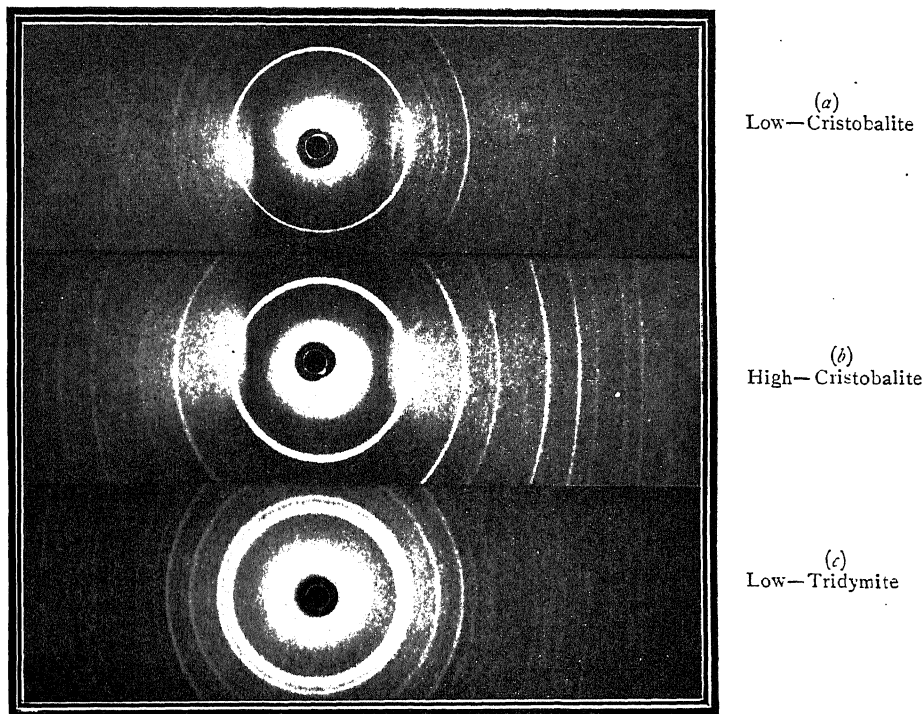


FIG. 2. X-Ray Diffraction Patterns

balite, in other features they resemble that of tridymite, especially in the fact that the principal ring of the opals is a multiplet. The demonstration that the structure of the opals includes both tridymite and high-cristobalite is completed when the patterns are recorded with X-ray cameras of higher resolution. The principal ring is then seen resolved into three components; the positions and relative intensities of these agree with those to be expected as a result of the superposition of the single ring of high-cristobalite with the three rings of tridymite.

4. THE OPTICS OF STRATIFIED MEDIA

The optical phenomena which result from the passage of a beam of light through a regularly stratified medium are determined by the spacing of the stratifications and the direction

light. The water-opal illustrated in Fig. 1 (b) represents this middle stage. Many of the coloured internal reflections that it exhibits are yellow and red, indicating that the spacings of the stratifications are still large. With finer stratifications, even the backward reflections disappear for the longer wavelengths of the spectrum, only the blue and violet reflections being then possible. The size of the domains covered by the stratifications also plays a role. If they are small enough, we obtain a diffusion of the light in all directions instead of a regular reflection in any particular direction.

The extraordinarily perfect monochromatism of the reflections and of the corresponding extinctions displayed by fine opals is a proof that their stratifications fulfil simultaneously four conditions, (a) that their number in any

given domain is large, (b) that their spacing is uniform, (c) that the difference of refractive index between the alternate stratifications is constant, and (d) that such difference in index is very small. If any one of these four conditions is violated, the reflections would cease to be monochromatic. The only reasonable hypothesis that would cover these requirements is that the alternate layers in the material consist of two distinct crystalline modifications

close association with low-tridymite. Evidently, the presence of the latter stabilises the situation and prevents the reversion of the high-cristobalite to the low-temperature form. The X-ray patterns indicate that the high-cristobalite forms the larger proportion of the material, and since it is optically isotropic, one can readily understand why opal is reasonably transparent. On the other hand, since low-tridymite is a crystal possessing a pseudo-

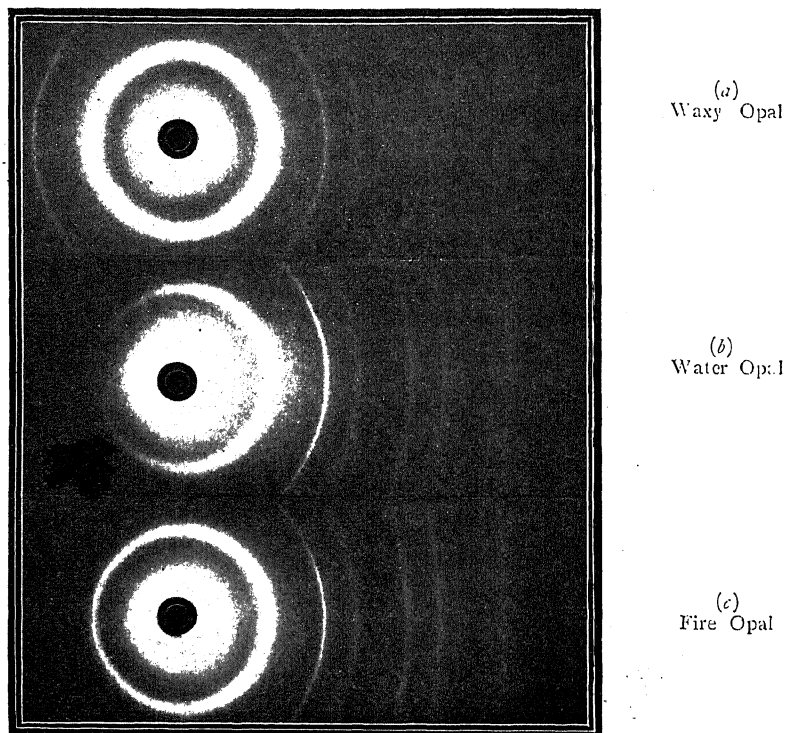


FIG. 3. X-Ray Diffraction Patterns

of silica. The X-ray data indicate that these two modifications are respectively high-cristobalite and low-tridymite and thus furnish the clue to the understanding of the observed optical behaviour of precious opal.

5. SOME FURTHER REMARKS

High-cristobalite, as is indicated by its X-ray pattern, is a cubic crystal with a structure resembling that of diamond in its general plan. It reverts immediately to low-cristobalite at temperatures below 270° C. It seems at first sight, therefore, surprising that it should continue to exist as such as a constituent of opal. The answer to the puzzle is furnished by its

hexagonal symmetry, it is not surprising that the stratifications in opal often exhibit geometric patterns in three dimensions.

It is important to remark also that not all opals give beautifully well-defined X-ray patterns of the kind illustrated in Fig. 3. Indeed, it is found that many opals give diffuse patterns resembling those of vitreous silica, though there are recognizable differences. A careful comparison of the X-ray patterns and of their optical behaviour, however, leaves no room for doubt that they are essentially similar to hyalite in their structure.

C. V. RAMAN.

THE PROBLEM OF THE 'DANIAN'—A REVIEW

L. RAMA RAO

OF all the smaller subdivisions of the standard European stratigraphical scale, the Danian is one of the most interesting, and has attracted considerable attention ever since it was first recognized as a distinct unit in the Upper Cretaceous succession of Denmark more than a hundred years ago. Its special importance is due to the position which this subdivision occupies on the Cretaceous-Eocene boundary; a proper understanding of its stratigraphical and palæontological relationship and affinities with the underlying Cretaceous on the one hand, and the overlying Eocene on the other is therefore of the greatest value in the study of the Cretaceous-Eocene transition. To us in India, this subject is of particular interest since beds of 'Danian' age have been noticed in quite a number of places and their proper study and interpretation play a very important part in discussing the Cretaceous-Eocene boundary problem here.

In Denmark where it was first studied, the Danian was considered as representing the subdivision at the very top of the Cretaceous, and composed of two parts.

Upper: Saltholm limestone with *Nautilus danicus* and *Baculites* also.

Lower: Faxoe chalk: full of corals and bryozoa, with *Nautilus danicus*, *Belemnites mucronata* and *Baculites fauasi*.

A little later, the Danian subdivision was also described from the Franco-Belgian basin where it was classified as under:

Danian { Montian
 { Mæstrichtian

The Danian here is mostly composed of a pisolitic limestone which occurs in a number of places always lying unconformably on different parts of the chalk. It was recognised, however, even in those days that the different outliers of these beds were not all of the same age, and that while some of them undoubtedly belonged to the latest parts of the Cretaceous system, others formed 'passage beds' into the younger Tertiary. Of the fossil assemblage in this Danian and its significance, it was said: "The general aspect of the fossils resembles that of the older Tertiary formations; but among these, there are some undoubted Cretaceous species.....The fragmentary deposits in which this transition can be traced are interesting in so far as they help to show that though in Western Europe, there is on the whole a

tolerably abrupt separation between Cretaceous and Tertiary deposits, there was nevertheless no real break between the two periods—the one merged insensibly into the other."

Some years later, based on the work in N.-W. France, the Danian of that area was described as composed of two subdivisions as follows:

Danian { Calcaire Pisolithique—zone of *Nautilus danicus*.
 { Calcaire à Baculites—zone of *Baculites anceps*.

This differentiation of the Danian into two distinct zones, the lower with *B. anceps* and the upper with *N. danicus*, and the transfer of the Montian to the Tertiary, were important steps in the right direction.

As time went on, other ideas about the Danian and its stratigraphical relationships have been expressed in more recent years; and it will be seen from the following review recently made by Muller and Schenck¹ (1943) that the position regarding the Danian even in Europe is still uncertain: "In Belgium are some beds called Montian. These have been correlated with type Danian by several authors and placed in the Cretaceous. Others consider the Montian to be younger than the Faxoe limestone, but still Cretaceous. Another school holds a third view, the Montian is contemporaneous with the Danian, but both are Tertiary. Still others hold that the Montian being younger than the Faxoe limestone is Tertiary, whereas the Danian is Cretaceous. The upper limit of the Cretaceous system is not settled in Europe, much less so elsewhere."

Outside Europe, Grabau² (1927) drew our attention to the occurrence of certain uppermost Cretaceous beds immediately below the Paleocene (?) Libyan series of Africa, but pointed out that there was invariably a disconformity between the two. He nevertheless made the important observation that these late Cretaceous strata already show tertiary affinities in their faunal content. An important contribution to our knowledge of the 'Danian' subdivision was recently made by Finlay and Marwick³ (1937) in their stratigraphical and palæontological studies of the Wangaloan and associated marine beds of New Zealand, about the exact age of which there was some difference of opinion among previous workers, some assigning them to the topmost Cretaceous, and others to the lowermost Tertiary. After a detailed examination and analysis of the palæontological

evidence, Finlay and Marwick emphasized the distinctness of the Wangaloan fauna from other faunas, both Cretaceous and Tertiary. After considering all factors, they opined that a late Cretaceous age (approximately Danian) may be assigned to them, and further indicated "that the time between the Mæstrichtian and Montian covered a longer period than generally conceded, and the probable need for other stages in addition to the Danian to fill the gap." Their conclusion regarding the stratigraphical position of the Wangaloan beds has been nicely summarised as follows: "In a general way the Wangaloan is related to the Cretaceous and Tertiary much the same as the Danian is. It is therefore here placed at the top of the Cretaceous and correlated with the Danian. If the evidence supplied by New Zealand mollusca is significant, the period between the Mæstrichtian and the Paleocene was a very long one, much longer than is generally conceded. Consequently the Wangaloan stage, though falling within this period need not coincide with the Danian. It may be earlier, it may be later, or the stages may, in part, overlap."

An altogether different view regarding the concept of the Danian has been expressed quite recently (1949) by S. W. Tromp⁴ in his paper on "The determination of the Cretaceous-Eocene boundary by means of quantitative, generic, microfaunal determinations and the conception 'Danian' in the Near East." In this very interesting paper, Tromp has examined the 'microfaunal' data furnished by the Cretaceous-Eocene border line beds in the countries of the Middle East, and says that on this micropalæontological evidence, the Cretaceous-Eocene boundary "cuts through the so-called Danian, and makes this term superfluous, at least in the Middle East. Further evidence suggests that in other countries also the term Danian is useless as an accurate stratigraphical unit and should be abandoned." He thinks that the introduction of the name Danian was at one time useful "only because of the great difficulty experienced in determining the Cretaceous-Eocene boundary by means of macrofossils"; with the present advent of microfaunal studies, this division according to Tromp is no longer justifiable or necessary.

From a study of the Foraminifera, Glaessner¹⁰ (1945) says of the Danian: "Important elements of the Paleocene and later Tertiary fauna are present in the Danian. In the history of the Foraminifera, the Danian appears thus as a transition period. The cycle of Upper Creta-

ceous development closes with the sudden extermination of almost all dominant elements of the fauna before the Danian. The new cycle commences in the Paleocene."

With this brief review of the discussion regarding the stratigraphical position of the 'Danian' beds in other countries, we may now consider the case in India where beds correlated with the 'Danian' subdivision have been recognised in quite a number of places both in the peninsular and extra-peninsular regions. A brief account of these beds and their importance in discussing the problem of the Cretaceous-Eocene boundary here have been given by the present writer in his Presidential Address to the Geology Section of the Indian Science Congress (1940) on the Upper Cretaceous and Lower Eocene beds of India, with special reference to the Cretaceous-Eocene boundary. For purposes of this article, attention will be drawn to a few points of special interest worthy of consideration in discussing the stratigraphical position of the Danian.

The most interesting feature, noticed from very early times, of many of these so-called 'Danian' beds which we are now accustomed to regard as belonging to the uppermost Cretaceous horizon, is that they also contain some fossils with a distinct Tertiary aspect. This was pointed out by W. T. Blanford⁵ even so far back as 1880 when describing the Cretaceous succession in Sind; in assigning an age to the topmost beds here which he called the "Cardita beaumonti beds", he said they were "upper Cretaceous or intermediate between Eocene and Cretaceous." He observed: "The fossils in the 'Cardita Beaumonti beds' require much fuller examination and comparison than they have hitherto received; but sufficient has been ascertained to show that they have a distinctly Cretaceous character, but that nevertheless they have strong Tertiary affinities... Although the latter group (Cardita beaumonti beds) have been classed as Cretaceous, this classification must be understood as only temporary, for the thorough examination of the fossils may show that the preponderance of affinities is really very ancient Eocene, or absolutely intermediate between the oldest Tertiary and the newest Cretaceous formation hitherto known." The position was much the same in regard to the limestone occurring just below the Deccan Traps in the Rajahmundry area. William King⁶ who first described it in 1880, noticed that "the majority of fossils are such as are usually considered as of Tertiary age"; but his colleagues

Medlicott and Blanford were not so sure about this, for they said: "Although the whole facies is Tertiary, there is a remarkable absence of characteristic genera, and the chief distinction from the Cretaceous fauna of the upper beds in South India is simply the want of any marked Cretaceous form.... The balance of evidence is in favour of referring the latter (infra-trappeans) to Cretaceous time rather than to Tertiary. They may be of intermediate age." Then again in the Trichinopoly Cretaceous area the topmost beds constituting the Niniyur group offer a similar doubtful position. In describing them so far back as 1865, H. F. Blanford⁷ commented on their fossil assemblage as follows: "It will be seen that the Tertiary aspect of the fossils of the Niniyur bed is more due to the absence of characteristic Cretaceous forms than to the presence of those which we have been accustomed to think as peculiar to Tertiary deposits; but the latter are not entirely wanting."

In all these three areas, Sind, Rajahmundry and Niniyur, further work was done in later years, and we gradually came to adopt the view now current that in each of these places, the beds in question must be considered as definitely belonging to the Cretaceous, and representing its uppermost horizon equivalent to the 'Danian'. In coming to this conclusion, we relied very largely on the evidence of one or both of the fossils,—*Cardita beaumonti* and *Nautilus (Hercoglossa) danicus*—which seemed to clinch the issue in favour of the Danian age.

But this implicit confidence of ours in the value of these fossils as specific Danian age indicators has been rather severely undermined by the more recent researches on the nature and distribution of these index fossils and their use in long distance correlations of small stratigraphical subdivisions. Our attitude regarding *Cardita beaumonti* as a zone fossil, for instance, has to be completely changed in view of the recent investigations by Rutsch⁸ (1936) who made a thorough study of the occurrence of this fossil in different parts of the world and pointed out that the so-called *Cardita beaumonti* of these different areas is not quite the same, though closely similar; and if all these allied forms are grouped together, the range of this '*Cardita beaumonti* group' is much longer and ranges from Mæstrichtian to Middle Eocene. This paper by Rutsch is exceedingly valuable, not only because it deals with the problem of *Cardita beaumonti*, but also because it raises certain basic and fundamental issues which we have to consider in dealing with the

age value of any other similar so-called 'index fossil' with a wide geographical distribution. It would be desirable, for instance, to examine the evidence of the other 'Danian' fossil *Nautilus (Hercoglossa) danicus* dealing with this problem in the same manner as Rutsch has done in the case of *Cardita beaumonti*. Such a study is likely to reveal the presence of a '*Nautilus danicus* group' with an extended time range, and may to that extent caution us against the uncritical manner of using this fossil either, as a decisive index of a 'Danian' age. Such studies are obviously particularly necessary when we have to determine the exact age of 'border line' beds.

Side by side with these studies, the other constituents of the entire fossil assemblage in these so-called 'Danian' beds of different areas have also been examined in recent years, and it is being increasingly realised that they include several fossils of the kind associated with the early Tertiaries, as was already indicated by the pioneer workers. Thus in 1930, L. R. Cox, on the basis of Douville's work, pointed out that the *Cardita beaumonti* beds "contain a number of species allied to, or even identical with, forms which in Europe are characteristic Eocene species", and later in 1939, suggested "that the typical fauna of the *Cardita beaumonti* beds might be of basal Paleocene age rather than uppermost Cretaceous." In 1940 L. M. Davies actually referred the *Cardita beaumonti* fauna (provisionally) to the Montian. From his studies of the Niniyur group of the Trichinopoly Cretaceous area (1936 & 1940), the present writer⁹ pointed out the presence of certain Tertiary features in its fossil assemblage and said: "The fossils generally seem to indicate a Danian age; but it appears not unlikely that a part at least of the Niniyur Division represents even an younger horizon."

Following these trends of thought, it would appear that we may soon have to transfer many of these so-called 'Danian' beds actually into the early Tertiary; modern research seems in fact to be definitely pointing in this direction. It may even be that we will ultimately have to do away with the 'Danian' subdivision altogether—handing over part of it to the Mæstrichtian (Cretaceous), and transferring the other part to the Paleocene (Tertiary). In the present stage of our knowledge, however, all these 'Danian' beds are best considered as occupying a part of the 'passage' between the Cretaceous and Eocene without assigning it to either of these systems. From one point of view this passage belongs

to both; from another it belongs to neither. The detailed study of such 'passage beds' wherever they occur would be of the greatest value in contributing to complete our world picture of the geological history during the Cretaceous-Eocene transition period.

1. *A.A.P.G.*, 1943, 27 (3).
2. *Bull. Geo. Soc. China*, 1927, 6 (2).
3. *N. Z. Geo. Sur. Pal. Bull.*, 1937, 15.
4. *Jou. Pal.*, 1949, 23 (6).
5. *Mem. Geo. Sur. India*, 1880, 17.
6. *Ibid.*, 1881, 16 (3).
7. *Ibid.*, 1865, 4 (1).
8. *Ecl. Geo. Helv.*, 1936, 29 (1).
9. *Proc. Ind. Sci. Con.*, 1940, 2.
10. *Principles of Micro-paleontology*, 1945.

BIOSYNTHESIS BY ALGAE

DURING the Rationalization Exhibition held in July-August 1953, at Dusseldorf, the 'Kohlenstoffbiologische Forschungstation' at Essen-Bredeney, exhibited a pilot plant using a culture of algae for the biosynthesis of organic substances such as fats, proteins and carbohydrates.

The idea behind the scheme is to provide favourable conditions for biosynthesis by utilizing industrial waste gases (CO_2 and heat) and solar energy. Vertical glass columns of about 2 metres in length are arranged about a vertical axis. These are filled with a nutrient solution containing nitrogen, phosphorus, potassium and other minor elements. To these a suspension of algae is added. A mixture of air and CO_2 from waste gases, freed from harmful matter, in particular sulphur, is blown through the solution. The whole is exposed to sunlight while a neon tube situated in the middle of the system of vertical tubes supplies

artificial light when required. The CO_2 added is about 2 per cent. by volume. The algae propagates rapidly.

After a period of 1-2 days, one half of the liquid is drained off for centrifuging. The substance separated is then dried. It has a content of proteins or lipoids depending on the composition of the nutrient solution. High nitrogen content of the solution results in a dry substance containing 50-60 per cent. proteins. Low nitrogen content, on the other hand, results in a dry substance of about 15 per cent. lipoids. Sterile culture can be made with this glass column method only with the algae species *Chlorella vulgaris*, of the variety "viridis". The fats, proteins and carbohydrates obtained by this method can be used for many purposes after hydrolytic processing such as an ingredient for animal food and as raw materials for the chemical, pharmaceutical and cosmetic industries.

SYMPOSIUM ON INDIGENOUS DRUGS AND INSECTICIDES

AT a Symposium on Indigenous Drugs and Insecticides held under the auspices of the National Institute of Sciences of India at Bombay in August 1953, forty-one papers were presented by about 60 authors working in 22 different laboratories of the country. The material was divided into two groups, viz., (I) Indigenous Drugs, and (II) Insecticides. Under the first group, thirty-five papers dealing with (a) chemistry of plant products, (b) pharmacology and chemotherapy of plant products, (c) biochemistry of plant products, (d) therapeutics of plant and mineral products, (e) pharmaceutical botany and pharmacognosy of medicinal plants, and (f) general aspects, were included. There were six papers in the second group. A perusal of the abstracts of the papers

reveals that a successful attempt has been made to cover the different aspects of this wide subject.

In our country where the native systems of medicine like Ayurveda, Siddha and Yunani, have successfully thrived side by side with the fast-advancing allopathic system, intensive pursuit of organized and systematic study of indigenous drugs is of paramount importance for the scientific development of the former systems of medicine. It is happy that the National Institute of Sciences organized this Symposium, which should act as a stimulant for increased activities in this useful field. The full papers, when published, will be read with great interest.

B. H. IYER.

ISO-FLAVONES OF SOYABEANS

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SOYABEANS were shown by Walz¹ to contain genistein (5:7:4'-trihydroxy isoflavone) and daidzein (7:4'-dihydroxy isoflavone). Later Okano and Beppu² claimed to have isolated 5:7:2'-trihydroxy isoflavone ("iso-genistein") and 5:7:4'-trihydroxy-8-methyl isoflavone ("methyl genistein") and 5:7:2'-trihydroxy-8-methyl-isoflavone ("methyl-iso-genistein"). Compounds of these constitutions have recently been synthesised by Seshadri and Varadarajan³ and have been found to differ from the natural products in melting points and colour reactions with alcoholic ferric chloride. The derivatives and degradation products also are found to be different. The work of Baker *et al.*,⁴ Karmarkar *et al.*⁵ and of Whalley⁶ have independently led to the same conclusion. Baker *et al.*⁴ have made the suggestion that the samples reported as methyl genistein, methyl iso-genistein and iso-genistein by Okano and Beppu were all genistein of varying degrees of purity. This was considered to be more likely because the elementary analysis is not inconsistent with this suggestion and some of the supposed hydrolysis products were not satisfactorily characterised. One significant point may be emphasised here with regard to the claims of Okano and Beppu of having isolated 8-methyl genistein and 8-methyl isogenistein. It is now established that all 6 or 8 C-methyl chromone derivatives⁷ give a characteristic deep green colour with alcoholic ferric chloride while those without the C-methyl group give a violet or brown colour. Synthetic 8-methyl genistein and 8-methyl isogenistein give deep green colour whereas the samples of Okano and Beppu are reported to give violet red or brown colour.

Baker *et al.*⁴ have further suggested that the product "tatoin", supposed to be 5:4'-dihydroxy-8-methyl isoflavone which was isolated by Okano and Beppu from Soyabeans and by Bhandari, Bose and Siddiqui⁸ from Soyabean germs may prove to be identical with daidzein (7:4'-dihydroxy isoflavone), because the melting points of dimethyl daidzein is 162-63°^{9,10,11} the same as that recorded by Okano and Beppu for the so-called dimethyl tatoin (165°) and the melting point of the diacetate of daidzein (182°) is also the same as the melting point of diacetate of tatoin (185°) recorded by Okano and Beppu. Earlier Walz¹ had recorded the lower m.p. of 153° for dimethyl daidzein and this might have given room

for the claims of Okano and Beppu. This m.p. has been corrected later as mentioned above.

In view of the marked differences noted by Seshadri and Varadarajan³ between the synthetic products and the natural ones isolated by Okano and Beppu,² it was considered necessary to attempt their isolation from soyabeans. Work was started in this connection long before the suggestion of Baker for explaining the discrepancy was published. The soyabeans employed in the present investigation were of the yellow variety (Pusa selection) called "Glycine Max", kindly supplied by the Indian Agricultural Research Institute, New Delhi. The ground beans (3 lb.) were extracted first with petroleum ether which removed only oily matter. Subsequently extraction was done with hot ethyl alcohol. The alcoholic extract was distilled under reduced pressure to about 75 c.c. and finally extracted with petroleum ether to remove the remaining oily impurities. It was then repeatedly extracted with ether. The ethereal extract on distillation gave a small quantity of a crude product (A). It was crystallised twice from methyl alcohol when it gave a small quantity of a product (B) melting at 316-17° with decomposition. This had all the properties recorded for "tatoin" by Okano and Beppu.² The aqueous alcoholic residue left after extraction with petroleum ether and ether was boiled with 7 per cent. sulphuric acid for 2 hours. There was no solid product, neither could anything be obtained by ether extraction.

Later extraction of the germs was done adopting the procedure of Siddiqui *et al.*⁸ About 60 lb. of soyabeans were germinated and the germs extracted, and about 300 mg. of a crude product (C) was obtained. It was repeatedly crystallised from methyl alcohol when a small quantity of a crystalline product (D) (50 mg.) was obtained. It melted at 316-17° C., mixed melting with the above sample (B) was undepressed.

At first the crude products (A) and (C) were subjected to circular paper chromatography following the procedure of Krishnamurty and Seshadri (unpublished work) for isoflavones. The irrigating solvent was alcohol-water (1:3) mixture. When the chromatogram was developed with alcoholic ferric chloride it gave a green ring having circular R_f 0.63. This agreed with that of an authentic sample of genistein.

On the other hand when the chromatogram was developed with ammonical silver nitrate another pink ring with R_f 0.9 became visible and this was found to agree with the R_f value given by an authentic sample of daidzein under similar conditions. It therefore appeared that these were mixtures containing genistein and daidzein. Sample (C) which was available in larger quantity was separated by subjecting it to partial methylation using two moles of dimethyl sulphate. Under these conditions the dimethyl ether of daidzein and genistein would be produced and they could be separated by extraction with alkali in which the latter would be soluble by virtue of the free 5-hydroxyl (resistant) it would still possess. Experimental details are given below.

The mixture (230 mg.) was dissolved in anhydrous acetone (50 ml.). Dimethyl sulphate (2 mol.; 0.16 ml.) and anhydrous potassium carbonate (1 g.) were added and the mixture gently refluxed for 8 hours. The solvent was then distilled off and water added to the residue. It was then extracted with ether. The ethereal layer was repeatedly extracted with sodium hydroxide solution (3 per cent.). The ether solution was marked (E) and the alkaline solution (F). The alkaline solution (F) was acidified with hydrochloric acid. It was re-extracted with ether, the ether distilled off and the residue crystallised from a mixture of ethyl acetate and petroleum ether when a colourless product was obtained. It gave a green colour with alcoholic ferric chloride solution, and melted at 233-35° with previous sintering at 210-15°. It appeared to be a mixture containing mono- and dimethyl ethers of genistein. It was therefore completely methylated with excess of dimethylsulphate and potassium carbonate in anhydrous acetone medium and the trimethyl ether finally crystallised from ethyl acetate petroleum ether mix-

ture. It melted at 163-64°, yield 150 mg. Mixed melting point with an authentic sample of trimethyl genistein was undepressed. The ether solution (E) was distilled and the residue crystallised from a mixture of ethyl acetate petroleum ether when dimethyl daidzein melting at 162-63° was obtained; yield 70 mg. Mixed melting point with an authentic sample was undepressed. Approximate composition of the mixture was 70 per cent. genistein and 30 per cent. daidzein.

The fairly sharp melting samples (B) and (D) agreeing with the reported properties of 'tatoin' were finally examined by chromatography. Both of them gave two rings (1) R_f 0.63 with alcoholic ferric chloride, and (2) R_f 0.9 with ammonical silver nitrate. Thus they also proved to be mixture though diadzein appeared to be the major component.

The above experiments definitely show that the soyabeans contain only genistein and daidzein and give strong support to the contention that '8-methyl genistein', 'isogenistein' and '8-methyl-isogenistein' are only genistein of varying degrees of purity, and that 'tatoin' is only daidzein containing as impurity genistein.

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SYMPOSIUM ON ELECTROCHEMICAL PROCESSES

WITH the approval of the Council of Scientific and Industrial Research, it has been decided to hold a symposium on "Electrochemical Processes and Their Applications to Indian Industries", in the Central Electrochemical Research Institute, Karaikudi, sometime during the month of February 1954.

Even if the intending participants are not in a position to be present at the symposium, they are requested to forward their papers to the Convener of the Symposium who will arrange for getting them read and discussed at the

symposium. The symposium includes sections on electrothermal processes, metallurgical and non-metallic industries, electric furnace technology, electrolytic processes, inorganic and organic chemical industries, electric batteries, electrodeposition and allied processes, electric discharges and their application, electroanalyses and applications. It is open to the contributors to deal with the fundamental and theoretical or applied aspects of any of the subjects which generally fall within the scope of the above sections.

Rh SUBGROUPS IN SOUTH INDIANS

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THE incidence of the Rh factor in Indians has been worked out by various authors. Most of the investigators have used anti-Rh serum of anti-D specificity only. Wiener¹ and Greval² tested Indians with anti-D, anti-C and anti-E sera. Ranganathan *et al.*³ tested 294 South Indians with anti-D, anti-C and anti-c sera. Prasad *et al.*⁴ tested 105 Indian students in London with anti-C, anti-D, anti-E, anti-c and anti-e sera. The present investigation has been undertaken with a view to get sufficient data about the distribution of the Rh groups in South Indians.

The tests were carried out on 100 medical students. The red cells were tested with anti-Rh sera, anti-D, anti-C, anti-E and anti-c sera. Dried sera and preserved liquid sera were employed. Landsteiner's tube method was used for the tests. The results were read macroscopically and confirmed by microscopic examination. Reliance was placed only on the microscopic reaction because on a number of occasions a negative macroscopic reading gave an unmistakable presence of agglutinates when viewed under the microscope and a positive macroscopic reading on rare occasions showed no agglutination under the microscope. The specimen of cells which gave a negative reaction with the anti-D serum was retested for confirmation.

The results obtained with the various anti-sera have been tabulated in Table I which in-

TABLE I
Incidence of Rh subgroups

| Reactions with anti-sera | | | | South Indians (present study) | Indians (Prasad <i>et al.</i>) ⁴ | Hebrews ⁵ |
|--------------------------|--------|--------|--------|----------------------------------|----------------------------------------------------|----------------------|
| Anti-C | Anti-c | Anti-D | Anti-E | | | |
| + | + | + | - | 30 | 32.38 | 35.00 |
| + | - | + | - | 32 | 35.24 | 29.29 |
| - | + | - | - | 8 | 7.62 | 7.86 |
| - | + | + | + | 6 | 3.81 | 5.00 |
| + | + | + | + | 20 | 16.19 | 17.14 |
| - | + | + | - | 3 | 2.86 | 3.57 |
| - | + | - | + | 0 | .. | 0.00 |
| + | + | - | - | 0 | 1.90 | 1.43 |
| - | - | + | + | 1 | .. | 0.71 |
| + | + | - | + | 0 | .. | 0.00 |
| + | - | - | - | 0 | .. | 0.00 |

Percentage of positives in South
Indians with the sera:

82 67 92 27 100 100.00 100.00

cludes the results obtained by Prasad *et al.*⁴ for Indians, and the results for Hebrews in Canada⁵ for comparison.

Table II shows the Rh chromosome frequencies of South Indians compared with those obtained by Prasad *et al.* for Indians.

TABLE II
Rh Chromosome frequencies expressed as percentages

| Chromosome | South Indians (present investigation) | Indians (Prasad <i>et al.</i>) ⁴ |
|------------|------------------------------------------|-------------------------------------------------|
| CDe | 56.57 | 56.64 |
| cde | 28.28 | 24.77 |
| cDE | 9.40 | 10.48 |
| cDe | 4.88 | 4.27 |
| CDE | 0.87 | 0 |
| Cde | 0 | 3.85 |

Our results show a frequency for D-negative of 8 per cent. The figures obtained by other workers vary from 2 to 10 per cent. as pointed out by Prasad *et al.* The variation might be due to different workers testing different populations, and probably also due to technical errors. The chromosome frequencies obtained by us agree closely with those obtained by Prasad *et al.* except for Cde and CDE.

When the distribution of the phenotypes in South India is compared with the incidence of phenotypes in the different races in the world,⁵ there is a striking resemblance with the phenotypes in Hebrews in Canada while some similarities and some differences occurred with some other races. We are not able to explain this interesting feature as we have insufficient ethnological data.

When the Kahn tubes after the tests were soaked in 1:1,000 nitric acid overnight and then cleaned in tap water, rinsed in distilled water and autoclaved for use, washed red cells in saline suspension in such tubes showed clumping even without the addition of the stock serum, due evidently to trace impurity of serum sticking to the wall of the narrow tube. But when a saline suspension containing unwashed cells was put into the tube no agglutination occurred. These were consistently seen in several observations spread over some days. This leads us to suspect that the serum may contain an inhibitor factor against agglutination, and probably when this is present in high

concentration the prozone phenomenon occurs. Further work on the suspected inhibitor factor is in progress. Tubes soaked overnight in dichromate sulphuric acid mixture, brushed, cleaned in tap water and rinsed in distilled water and autoclaved did not give any false reactions.

We wish to thank Dr. Mourant, Blood Group Reference Laboratory, London, the Rockefeller

Foundation and the Ortho Pharmaceutical Company for the supply of the sera.

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2. Greval *et al.*, *Nature*, 1946, **157**, 411.
3. Ranganathan *et al.*, *J. Ind. Med. Assoc.*, 1948, **17**, 162.
4. Prasad *et al.*, *Am. J. Phy. Anthr.*, 1949, **7**, N.S. No. 4, 553.
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NOBEL AWARD FOR MEDICINE AND PHYSIOLOGY—1953

THE NOBEL PRIZE FOR MEDICINE AND PHYSIOLOGY for 1953 has been awarded jointly to Prof. H. A. Krebs, Professor of Physiology in the University of Sheffield and Director of the Medical Research Council Unit for Research in Cell Metabolism, and Dr. F. Lipmann, Head of the Biochemical Research Laboratories, Massachusetts General Hospital.

Prof. Krebs has mostly been concerned with the study of metabolic processes by experiments *in vitro*. The first of his two greatest contributions to biochemistry was from Freiburg in 1932, when he elucidated the mechanism of urea synthesis in the liver, by discovering the participation of ornithine, citrulline and arginine through a cyclical process—a concept of unprecedented nature. His subsequent observations on the deamination of amino acids demonstrated D-amino acid oxidase, and laid the foundations for future studies of the L-acids. In Cambridge in 1935 he proved the synthesis of glutamine from glutamic acid and ammonia in tissue slices. After moving to Sheffield, he announced in 1937 his second major contribution, the citric acid cycle. Before this, the path of oxidation of carbohydrates from pyruvate onward was unknown; although information was available, its significance was not appreciated. Krebs supplied the missing evidence and the idea, again that of a cycle, and the problem was solved. The citric acid cycle has stood the test of time, requiring only amplification of detail; it is concerned with oxidation of fat and protein as well as carbohydrate, provides paths for gluconeogenesis and amino acid synthesis, and is the chief source of metabolic energy. In recent years, Krebs's laboratory has been particularly concerned with the movement of substances across biological membranes, and he has studied the uptake of glutamic acid and potassium by tissue cells,

processes driven by energy from metabolism. He has also employed isotopes in the quantitative investigation of oxidative phosphorylation and ion transfer.

After studying the problems of muscle metabolism in Meyerhof's laboratory and of fermentation in Carlsberg Laboratory, Lipmann set the pattern for his future work when in 1937 he began to analyse the oxidation of pyruvate to acetate by bacteria. He found that the oxidation is accompanied by phosphorylation, and announced from Cornell University in 1939 that the 'energy-rich' ester acetyl phosphate is an intermediate. His celebrated article, "Metabolic Generation and Utilisation of Phosphate Bond Energy" (1941) organized and developed existing ideas and had the most profound influence on subsequent biochemical thought and research. Moving to Boston, Lipmann realized that acetyl phosphate is not formed in pyruvate oxidation in animal tissues; some other substance had to be sought. By a happy coincidence his own researches led to its identification. Studying the biological acetylation of sulphanilamide, he discovered a new coenzyme, coenzyme A (coenzyme of acetylation). Finding that it is a derivative of the vitamin pantothenic acid and a general constituent of living organisms, he quickly realized that it is of fundamental importance in carbohydrate and fat metabolism. By 1946 it was clear that some acetyl derivative stood at the entry to the citric acid cycle, on the paths of carbohydrate and fat oxidation and ketone-body formation. The idea grew that this was the acetyl derivative of coenzyme A, and was confirmed after the isolation of this substance from yeast by Lynen and Reichert in 1951. In the meantime Lipmann persevered in the purification of coenzyme A and as a result its structure has recently been settled.—(By courtesy of Nature.)

ROTHAMSTED EXPERIMENTAL STATION REPORT FOR 1952

THE report records the progress of work of the Rothamsted Experimental Station under the Directorship of Dr. Sir William G. Ogg, covering the researches conducted in its 15 departments. Brief accounts of the soil work in colonial territories, and of soil survey of England and Wales, and two special reviews, one on Micropredators in Soil and the other on the Production of Edible Proteins from Fresh Leaves are included. An introduction by the Director gives a summary of the researches conducted.

Like the earlier reports, the present one covers a wide range of investigations, and a brief review can hardly do justice to the contents of the report. Although by nature of its function, the research work at Rothamsted is directed towards applied agricultural aspects, the problems are, as far as necessary, tackled at their fundamental level and many results find confirmation in field trials. On several lines of investigation, sustained research over the past many years has either borne fruit or helped to clarify ideas on the subject.

Another feature of Rothamsted research has always been its simultaneous approach on problems from various angles. The report well illustrates this co-ordinated plan of work. One of the many striking instances of such teamwork is the study of viruses, which is being pursued in its various facets by the Plant Pathology, the Biochemistry, the Botany, the Entomology and the Insecticide and Fungicide Departments. Work is proceeding in this manner on many other complex problems.

Among the many researches presented in the report, there are some of special interest in India. Studies on fertilizer-placement and phos-

phate availability are two such. Researches on the nature of soil organic matter have indicated a profitable approach to the problem. Deep-ploughing is reported to have counteracted in a drought year its beneficial effects in favourable years. The tentative observation on the absence of any perceptible beneficial effect of krillium would help to temper possible enthusiasm for synthetic soil conditioners. The progress made in microbiological research is indicative of what can be achieved in India through a little additional attention to this much-neglected subject. Spraying nutrients on leaves may have wide applicable value, for the results show that apart from the increase in yield or protein-content of crops, nutrients received through leaves seem to lead to the absorption of the complementary nutrients from the soil.

The presentation of the investigations and results is noteworthy. Even excluding the Farm and Field Experiments Section, the Rothamsted Report contains over a hundred distinct items of research reported on about as many pages. On each item, the report is not only more or less complete; but also gives, where needed, a brief reference to earlier work, to collaborative investigations, and to the applicable value of the results obtained. Details of statistical check on results and references to the experimental controls employed are rightly left out to be presumed. The presentation is such that the intelligent lay reader, after a perusal of the report, is hardly left in doubt as to the necessity or utility of the investigations. It would be a very desirable improvement indeed, if a way could be found to adopt such a style of presentation in our reports in India.

N. L. DUTT.

BOSE RESEARCH INSTITUTE—36TH ANNIVERSARY MEETING

THE Thirty-Sixth Anniversary Meeting of the Bose Institute took place on November 30, 1953, when Dr. N. K. Bose, Director, River Research Institute, delivered the 16th Acharya Jagadish Chandra Bose Memorial Lecture on "The Role of Silt and Sand in Multi-Purpose River Valley Projects".

In the course of his Report, Dr. D. M. Bose, Director, observed that the investigations which the Institute has been doing during the last few years on the action of x-radiation in producing mutations in a few economic plants, has obtained a certain amount of recognition, and that the Institute has, on invitation from the National Institute of Sciences of India, submit-

ted a five-year scheme, which may be extended by another five years, relating to investigations on the mutagenic action of different kinds of radiation on plants. The latter will be selected mainly from the point of their suitability for genetic studies.

Preliminary investigations started during last year have disclosed that beta radiation from radioactive phosphorus, which is selectively absorbed in plant nuclei, is a very convenient tool for inducing mutation in plants. New types of effects are being observed in certain varieties of jute, in addition to those obtained after irradiation trials with x-rays extending over many years.

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NOTE ON THE ENERGY LEVELS OF TRIATOMIC MOLECULES*

It has been possible to simplify the mathematical theory of the asymmetrical top and the triatomic molecule by removing two of the Eulerian angles from the wave equation by a special artifice. An asymptotic expression for the eigen-values in the case of the asymmetrical top and the centrifugal and Coriolis corrections to the energy levels of the triatomic molecule have been obtained in closed forms for values of J exceeding 9 without solving any secular equation.

The wave equation of the asymmetrical top with moments of inertia A, B, C and the purely rotational part of the wave equation for triatomic molecules are reducible to the ordinary

differential equation

$$\left[g \left(\frac{d^2}{d\phi^2} + F \right) + \frac{1}{2} g' \frac{d}{d\phi} + \mu \right] u = 0$$

$$F = J(J+1) \quad (1)$$

where

$$g = 1 - k \cos 2\phi,$$

$$\mu = (E - cF) / \left(c - \frac{a+b}{2} \right),$$

$$E = \text{energy}, \quad a = h^2/(8\pi^2 A), \quad b = h^2/(8\pi^2 B),$$

$$c = h^2/(8\pi^2 C)$$

and

$$k = (b - a)/(2c - a - b)$$

is an asymmetry parameter whose values can be made to lie between 0 and 1/3. The lowest $2J+1$ eigen-values of Eq. (1) agree exactly

with those of the asymmetrical top. The equation, further reduced, can be solved by the B.W.K. method. The eigen-value equation obtained from the second approximation is

$$p[1+f(p^2)] = \frac{1}{2\pi} \int_0^{2\pi} \left[\chi^{\frac{1}{2}} + \chi^{-\frac{1}{2}} \left\{ \frac{k^2}{24} \cdot \frac{\sin^2 \theta}{g^2} + \frac{k \cos \theta}{3g} \right\} - \frac{\nu}{12} \cdot \frac{k \cos \theta}{g^2} - \chi^{-3/2} \right] \times d\theta = m, \quad (2)$$

an integer

where

$$\chi = f - \nu/g, \quad f = 1 + F, \quad \nu = -\mu + 1, \quad \theta = 2\phi, \quad p^2 = f - \nu.$$

In Eq. (2) the pairs of eigen-values corresponding to an odd and an even function do not show any separation, contrary to what is known from the exact theory. This degeneracy is not removed in the higher approximations, and the situation limits the application of the B.W.K. method to the highest and the lowest levels which are essentially degenerate. But, at least half of the energy levels for a particular value of J can be obtained from the present theory. If we impose the restriction, $\nu k/(f - \nu) \leq 1/4$, an expansion in powers of $\nu k/(f - \nu)$ is possible. In the case of maximum asymmetry corresponding to $k = 1/3$, the series has the form

$$10^3 \times f(p^2) = -30.33,0086 y - 8.990,294 y^2 - 1.201,758 y^3 - .4222,69 y^4 - .1177,46 y^5 - .04304 y^6.$$

+ $\frac{1}{p^2} \{ 22.74,756 + 1.055,83 y - 8.990,29 y^2 - 3.567,42 y^3 - 2.36,31 y^4 - 1.141 y^5 \}$
where $y = \nu/(f - \nu) = \nu/p^2$. This formula gives the energy of the highest level with an accuracy of 1 in 10^7 at least.

Triatomic molecules.—In the case of triatomic molecules a perturbation calculation gives the corrections to energy arising from centrifugal stretching and the interaction between rotation and vibration as averages of operators of the type P_x^2, P_y^2, P_z^2 , etc., over an eigen-function of Eq. (1). An examination of the Hamiltonian shows that the first order correction $E^{(1)}$ vanishes exactly, and the second order correction can be put into the form

$$E^{(2)} = \rho + \sum_i \sigma_i \bar{P}_i + \sum_{i,j} \tau_{ij} \bar{P}_i \bar{P}_j, \quad (i, j = 1, 2, 3, 4)$$

where, for brevity, we have written P_1, P_2, P_3, P_4 for $P_x^2, P_y^2, P_z^2, P_x P_y + P_y P_x$ respectively. The bars denote averages over the normalized eigen-function of Eq. (1) and $\rho, \sigma_i, \tau_{ij}$ are combinations of integrals over the vibrational functions.

In calculating the average values of the various operators we take, for the square of the rotational function u , the following approximate expression

$$u^2 = \frac{1}{2} (g\chi)^{-\frac{1}{2}} \left[1 \pm \cos 2 \int_0^\phi \chi^{\frac{1}{2}} d\phi \right]$$

and then show that the second term makes a negligible contribution to the integrals, if J exceeds 9 and ν satisfies the inequality $\nu k/(f - \nu) \leq 1/4$. If certain small terms are neglected the integrals then assume the surprising simple forms

$$\bar{P}_3 = -\frac{1}{2} N^2 \int_0^{2\pi} g^{-1} \chi^{\frac{1}{2}} d\phi$$

with

$$1/N^2 = \frac{1}{2} \int_0^{2\pi} g^{-1} \chi^{-\frac{1}{2}} d\phi$$

The centrifugal expansion terms $\tau_{ij} \bar{P}_i \bar{P}_j$ are evaluated in exactly the same way. For instance,

$$\bar{P}_3^2 = \frac{1}{2} N^2 \int_0^{2\pi} g^{-1} \chi^{3/2} d\phi$$

All the integrals occurring in the problem can be evaluated exactly in terms of elliptic functions. The dominant term in the eigen-value equation (2) has the value

$$\frac{1}{2\pi} \int_0^{2\pi} \chi^{\frac{1}{2}} d\phi = \frac{2\sqrt{f}}{\pi} [A - Z(\gamma)] K' + \sqrt{f} (1 - \gamma/K)$$

in the standard notation, where A and γ are constants depending on k and ν/f .

Complete calculations will be published elsewhere.

For interest and encouragement I offer my sincerest thanks to Professors S. N. Bose, M. N. Saha and S. K. Mitra.

Dept. of Physics, SUDHANSU DATTA MAJUMDAR,
Calcutta University,
Calcutta, November 28, 1953.

* Communicated by Professor S. N. Bose, Head of the Department.

ACHROMATIC COMBINATION OF TWO LENSES SEPARATED BY A DISTANCE

THERE is a minor error in the note by Mahendra Singh Sodha and Amara Nath Nigam on this subject.¹ The focal length of a combination of two lenses separated by a distance d is given by

$1/F = A(\mu - 1) + A'(\mu' - 1) - AA'd(\mu - 1)(\mu' - 1)$
but not as given by the authors with the last term having the positive sign. Consequently, the condition for achromatism is given by

$$A(d\mu/d\lambda) + A'(d\mu'/d\lambda) - AA'd\{(\mu-1)(d\mu'/d\lambda) + (\mu'-1)(d\mu/d\lambda)\} = 0$$

The expressions for the coefficients C_1 , C_2 and C_3 are

$$C_1 = Aca\{A'd(\mu_0'-1)-1\}$$

$$C_2 = A'c'a'\{Ad(\mu_0-1)-1\}$$

$$C_3 = AA'cc'd$$

Eqs. (7) and (8) are not altered by this correction, but Eq. (10) giving the constant focal length of the system should be altered as

$$1/F = A(\mu_0-1) + A'(\mu_0'-1) - AA'd(\mu_0-1)(\mu_0'-1).$$

An interesting result follows from this when the two lenses are of the same optical material. We have

$$1/d = A\{(\mu_0-1) - c/(\lambda_0 - \lambda_0')\} = A'\{(\mu_0'-1) + c'/(\lambda_0 - \lambda_0')\}$$

This may be rewritten as

$$1/Ad = (\mu_0-1) - c/(\lambda_0 - \lambda_0')$$

$$1/A'd = (\mu_0'-1) + c'/(\lambda_0 - \lambda_0')$$

If the material of both the lenses is the same, then

$$\mu_0 = \mu_0', c = c' \text{ and } \lambda_0 = \lambda_0'.$$

Hence

$$1/Ad + 1/A'd = 2(\mu_0-1)$$

or

$$d = \frac{1}{2} \{1/(\mu_0-1)A + 1/(\mu_0-1)A'\} = \frac{1}{2} (f + f')$$

where f and f' are the focal lengths of the two lenses for the refractive index μ_0 . This result is similar to the one generally used in the design of eye pieces consisting of two plano-convex lenses.

Madras Institute M. V. RADHA KRISHNA MURTY.
of Technology,
Chromepet, September 29, 1953.

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ORIENTATION POLARIZATION FROM SOLUTION DATA

In a recent note Palit¹ has derived an expression for directly computing orientation polarization from dilute solution data. It is the object of this note to point out that the author² has already derived a similar expression on the basis of (a) the Clausius-Mosotti expression for dielectric polarization, and (b) the linear dependence of specific volume of solution on concentration.

Comparison of the author's expression,

$${}_0p_2 = (v_1 + \beta) \left\{ \frac{3(\epsilon_1 - n_1^2)}{(\epsilon_1 + 2)(n_1^2 + 2)} \right\} + 3v_1 \left\{ \frac{\alpha}{(\epsilon_1 + 2)^2} - \frac{\gamma}{(n_1^2 + 2)^2} \right\}$$

with Palit's equation (expressed in the author's notation),

$${}_0p_2 = \left\{ \frac{3(\epsilon_1 - n_1^2)(1 - \beta_0/d_1)}{d_1(\epsilon_1 + 2)(n_1^2 + 2)} \right\} + \left\{ \frac{3\alpha}{(\epsilon_1 + 2)^2 d_1} \right\} - \left\{ \frac{6n_1\gamma_0}{d_1(n_1^2 + 2)^2} \right\}$$

reveals that since $\gamma_0 = \gamma/2n_1$, the only difference between these two expressions is the occurrence of a factor $(v_1 + \beta)$ in the first term of the author's equation in place of the factor $(1 - \beta_0/d_1)/d_1$ in the corresponding term in Palit's equation. This difference is due to the fact that Palit assumed linear dependence of density of solution with concentration, whereas the author considered specific volume to be linear. Since the linearity of specific volume with concentration in dilute solutions is justified theoretically under certain conditions³ and also on the basis of experimental observations^{3,4} we have,

$$v = v_1 + \beta\omega_2,$$

$$1/v = 1/(v_1 + \beta\omega_2) \cong (1 - \beta\omega_2/v_1)/v_1.$$

$$[\because \beta\omega_2/v_1 \ll 1 \text{ in dilute solutions}]$$

whereby

$$d = 1/v = (d_1 - \beta d_1^2 \omega_2)$$

or,

$$(v_1 + \beta) = (1 - \beta_0/d_1)/d_1,$$

thus making Palit's expression identical with that derived by the author.

It may also be pointed out here that the basis of Palit's expression is the equation

$${}_0p_2 = (\bar{p}_2)_{\omega_2 \rightarrow 0} = p_1 + (\partial p / \partial \omega_2)_{\omega_2 \rightarrow 0},$$

which is one of the ways of writing the Clausius-Mosotti expression as applied to dilute solutions. Hence Palit's initial procedure of substituting in his original equation the expressions for the linear variation of dielectric constant and density of solution with concentration amounts to a procedure identical with that adopted by Le Fèvre and Vine⁵ in their derivation of an expression for the computation of total polarization. The rest of the procedure adopted by Palit is identical with that of the author.² It may be pertinent here to add that even the observed linearity of dielectric constant of a dilute solution with concentration has been quantitatively explained by the author⁶ on a basis of the Clausius-Mosotti expression.

National Chemical Lab., B. R. Y. IYENGAR.
Poona-8, October 13, 1953.

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ESTIMATION OF DITHIONATE

Estimation of Dithionate

ESTIMATION of dithionate presents a difficult problem as it is resistant to many of the common oxidising agents. Potassium permanganate (acidic or alkaline), potassium dichromate, bromine in "Statu Nascendi" or ammonium vanadate have no perceptible action on dithionous acid or its salts under the usual conditions. On vigorous boiling, however, acidified dichromate¹ and vanadate² attack the dithionate and convert it quantitatively into sulphate. Mayer and Peyfuss³ recommend the use of concentrated hydrochloric acid to liberate bromine from a solution of a mixture of bromate and bromide at the boiling point to oxidise the dithionate in solution.

In the course of studies on the preparation and behaviour of sulphur compounds,^{4,5} it was found necessary to develop a rapid and reliable method for the estimation of dithionate in presence of other sulphur compounds. Taking into account the abovementioned observations a simple method was evolved for estimating the dithionate in presence of sulphide, sulphite, thiosulphate and other polythionates. A brief account of this procedure is given below.

An aliquot containing dithionate and any or all the other sulphur compounds (like sulphide, sulphite, thiosulphate and polythionates) is first treated with alkaline permanganate to oxidise all the sulphur compounds except dithionate.⁶ The alkaline permanganate can be made by adding 10-15 ml. of saturated permanganate solution to 10-15 ml. of 10 per cent. sodium hydroxide. After about 15 minutes, the excess of permanganate is removed by the addition of 2 per cent. manganous sulphate solution. The resulting manganese dioxide is filtered and washed off. The filtrate containing only dithionate is acidified with sulphuric acid in excess (10 N) and boiled for an hour with a known excess of potassium dichromate solution. After cooling, the excess of dichromate is estimated iodimetrically. A blank is also run and the dithionate equivalent of dichromate consumed is calculated.

The method evolved is found to be more convenient than the one described by Lang and Kurtenacker,² using an acidified solution of ammonium vanadate.

The present procedure was standardised using deci- and centi-normal solutions of sodium and barium dithionates. These salts were prepared according to the procedure described by Pfanstiel.⁷ The results of some representative analysis are given in the table.

| Quantity of Dithionate Taken* | Quantity of Dithionate Estimated | | | |
|-------------------------------|----------------------------------|-------|----------------|-------|
| | Lang and Kurtenacker's Method | Error | Present Method | Error |
| 1 29.84 | 29.56 | -0.9 | 29.68 | -0.5 |
| 2 18.68 | 18.44 | -1.3 | 18.54 | -0.7 |
| 3 15.24 | 15.02 | -1.2 | 15.12 | -0.3 |
| 4 8.76 | 8.67 | -0.9 | 8.71 | -0.5 |
| 5 4.87 | 4.81 | -1.2 | 4.84 | -0.6 |
| 6 2.75 | 2.72 | -1.1 | 2.77 | +0.8 |

* Quantities of dithionate are expressed in terms of mg. of sulphur.

It can be seen from the table that the method evolved gives better results than the Vanadate method.

The author wishes to express his grateful thanks to Prof. K. R. Krishnaswami and Dr. M. R. A. Rao for their kind interest in the work.

Dept. of Gen. Chem., A. R. VASUDEVA MURTHY,
Indian Institute of Science,
Bangalore-3, September 21, 1953.

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ELECTROLYTIC REDUCTION OF
SALICYLIC ACID TO SALICYL-
ALDEHYDE

SALICYLALDEHYDE is used largely in the synthesis of coumarin which is an important fixative in the industry of perfumes and flavouring essences. The general method of preparation of salicylaldehyde consists in heating phenol in alkali with chloroform, a process usually known as the Reimer-Tiemann reaction. Two isomers, with simultaneous *ortho*- and *para*-substitutions, are obtained by this method, the former, salicylaldehyde, being distilled in steam and so separated from the latter. The overall yield by this method is poor. Oxidation of *ortho*-cresol to salicylaldehyde is also another method that is carried out on an industrial scale.

The electrolytic reduction of salicylic acid to salicylaldehyde has been patented by Hugo

Weil¹ and later by Mettler.² The excellent results claimed by these authors could not be confirmed by Tesh and Lowy³ who carried out a thorough investigation of this process. The latter obtained, using sodium bisulphite for fixing the aldehyde as it was formed, yields approximating to 55 per cent. Lowy's results, however, were not reproducible by others⁴ who reported that they could obtain only 34 per cent. yield, according to his procedure. We repeated the experiments but could obtain not more than about 28 per cent. yield, following carefully Lowy's conditions. Very recently May and Kobe⁵ showed the importance of stirring in the reduction, using mercury as cathode, and obtained a maximum conversion of 50 per cent.

A thorough investigation of the process of electrolytic reduction of salicylic acid to the aldehyde has been undertaken in this Laboratory and as a result of the work done so far, conditions have been standardized to obtain consistent yields of 55 per cent. of salicylaldehyde, using mercury as cathode, and nearly 43 per cent. using a rotating cathode of amalgamated copper.

Procedure.—2 lb. of mercury in a 600 c.c. beaker of Pyrex glass served as cathode. 10 g. of sodium sulphate and 30 g. of boric acid in 120 c.c. water formed the initial catholyte. A blade type stirrer was employed to stir the catholyte. 14 g. of salicylic acid in 32.3 c.c. of 3.01 N/sodium hydroxide was added in amounts of 10 c.c. at a time, at intervals of 10 minutes (nearly 43 c.c.), the last addition being only about 3 c.c. 12 g. of sodium bisulphite were added during the course of reduction, in one gram lots every 5 minutes. The temperature was maintained at 15–18° C. and the current density at approximately 12 amps./dm.² A small porous pot supported on a glass tripod inside the beaker served as the anode compartment where a 10 per cent. sodium sulphate solution was used as anolyte with a lead strip as anode.

After the theoretical amount of current was passed, stirring was continued for half an hour longer and then the catholyte separated from mercury, neutralized with 20 c.c. concentrated sulphuric acid made up to 100 c.c. and steam distilled. Salicylaldehyde was ether extracted from the distillate, washed with sodium bicarbonate solution to remove any acid, dried over anhydrous sodium sulphate and the ether distilled off. 55 per cent. yield has been obtained in a typical experiment. In another experi-

ment, using double the quantities of chemicals, the same yield has been reproduced.

Attempts had been made by earlier workers to replace the large quantity of mercury by means of amalgamated cathodes, but without much success. Tesh and Lowy³ obtained only traces of aldehyde at an amalgamated copper cathode. May and Kobe⁵ used amalgamated lead and iron cathodes and did not find them suitable as a practical method.

The use of amalgamated brass and copper cathodes has now been investigated thoroughly with a fair degree of success. A rotating cathode with a number of discs (approximate area—0.55 dm.²), of the type used by one of us in an earlier investigation⁶ was used. At an amalgamated brass cathode 40 per cent. yield of salicylaldehyde was obtained using the same quantities of chemicals as above while at an amalgamated copper cathode, the yield was 42.5 per cent.

Strangely enough, using a stationary amalgamated cathode and an auxiliary stirrer, under identical experimental conditions, the yield of the aldehyde was observed never to exceed 10 per cent.

Further investigations using cathodes of amalgamated lead and other metals are in progress and full details would be published elsewhere.

Central Electro-Chemical B. B. DEY.

Research Institute, H. V. K. UDUPA.
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SZILARD-CHALMERS REACTION WITH COBALT PHTHALOCYANINE

A SAMPLE of cobalt phthalocyanine was irradiated with thermal neutrons in nuclear reactor at Harwell. It was dissolved in warm concentrated sulfuric acid. The phthalocyanine was reprecipitated by very gradual addition of a large excess of water (containing small amounts of cobalt sulfate), with continuous stirring, to the cooled acid solution. The precipitate was filtered out and decomposed by repeated treatment with fuming nitric and sulfuric acids.

'Equal Weight' cobalt samples of separable and retentive activity were obtained, by electro-

deposition from ammoniacal solutions of cobalt sulfate, containing hydrazine sulfate and ammonium sulfate. An electrodeposition cell with rotating carbon anode was used. The samples were measured at fixed geometry by means of an end-window G.M. tube.

The yield of the separable activity was about 95.5 per cent. The small retention obtained is in harmony with the fact that the phthalocyanines have a planar structure, thus offering little hindrance to the recoil cobalt atom.

Chemistry Division, AMAR NATH.
AEC, Bombay 26, JAGDISH SHANKAR.
November 14, 1953.

A SIMPLE PAPER CHROMATOGRAPHIC METHOD FOR THE ESTIMATION OF VITAMINS B₁ AND B₂

THE use of paper chromatography for the separation of vitamins B₁ and B₂ (Riboflavin) has been reported.¹⁻⁶ There is, however, very little information available on the application of this technique to the quantitative estimation of these vitamins. Brown and Marsh⁷ have described a paper chromatographic procedure for the quantitative estimation of the four water-soluble vitamins—B₁, B₂, B₆ and nicotinamide by means of a spectrophotometer with an automatic scanning device, to measure the total ultraviolet absorption. Quantitative determinations were made by measuring the areas of the zones of absorption corresponding to each component and comparing them with those of standard solutions. This method obviously cannot be used generally in ordinary laboratories lacking special equipment. The present communication deals with a simple and rapid method which can be used for the simultaneous separation, identification and quantitative determination of the two vitamins by circular paper chromatographic technique.⁸

The solution (5-10 μ) containing the two vitamins (0.5-2.5 μ g. of B₁ and B₂) was spotted on the circumference of a circle (2.2 cm. diam.) drawn at the centre of a circular filter-paper (18.5 cm. diam.). Standard solutions of the vitamins were spotted on either side of the test sample. Immediately after spotting, while still damp the spots were exposed to the vapours of cyanogen bromide and ammonia kept in separate petridishes and covered with a bell jar. The paper was allowed to remain for about 10-20 minutes until the spots were almost dry. By this treatment vitamin B₁ was transformed into thiochrome by cyanogen bromide. The paper was then removed and developed as usual by using *n*-butanol-acetic acid water (40 : 10 : 50)

as solvent mixture. After development the paper was dried at room temperature. The bands relating to thiochrome and riboflavin, which separated into two distinct bands, the thiochrome band occupying the position above the riboflavin band, were identified by their characteristic fluorescence, when observed under a filtered ultra-violet lamp (Phillips HP 125 W. analysing lamp). The use of cyanogen bromide in place of alkaline ferricyanide reagent, which is commonly used for transforming vitamin B₁ into thiochrome, was suggested by Fujiwara and Mutsui,⁹ and it is best suited for the identification of the vitamin by paper chromatography.

For quantitative estimation the bands relating to the vitamins were outlined with a pencil keeping the paper under U.V. lamp and cut out. The thiochrome was extracted from the paper with 6 c.c. of water and the fluorescence measured in a Klett Flurometer. The riboflavin was similarly extracted with acidified water and the fluorescence measured.⁴ By comparing the intensity of the fluorescence of the test sample with that of the standard solutions of the vitamins spotted on the same paper the amount of the vitamin present in the sample could be determined. A number of multi-vitamin preparations were tested by the above method and the results were reproducible to between 1-5 per cent. of the mean of four determinations for both the vitamins. A linear relationship between the intensity of fluorescence and the amount of the vitamins was found over the range 0.5-2.5 μ g. of each of the vitamins. A rough quantitative estimation of the vitamins was also possible by visual comparison of the intensity of the fluorescence of the bands with that of known amounts of the vitamins chromatographed on the same paper.

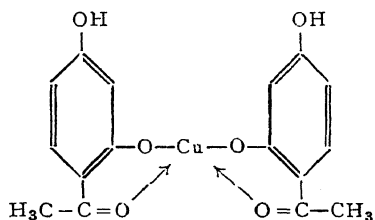
The method, being simple and rapid, is suitable for routine analysis of multivitamin preparations.

Dept. of Biochemistry, K. V. GIRI.
Indian Inst. of Science,
Bangalore-3, September 21, 1953.

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GRAVIMETRIC DETERMINATION OF COPPER WITH RESACETO- PHENONE

COOPER¹ introduced resacetophenone as a reagent for the detection of ferric iron in a weakly acid medium. This author reported that neither copper nor cadmium gave any precipitate in an acid medium (0.06 N hydrochloric acid; pH 1.56). In the course of investigations on the analytical applications of aromatic o-hydroxy-carbonyl compounds, the present author found that resacetophenone precipitates copper from a weakly acid solution buffered with sodium acetate (pH 5.6-6.2), while cadmium, cobalt, nickel and zinc remained in solution and did not interfere. The green precipitate obtained was soluble in ammonia producing a violet colour, the intensity of which increased with time. Preliminary experiments indicated a proportionality between colour intensity and copper content. (This aspect is being investigated in detail.) The copper complex was soluble in sodium hydroxide without decomposition, and was reprecipitated by adding acid. It was soluble both in dilute mineral and acetic acids. The complex decomposed only at ca. 220° C. and could be readily dried to constant weight at 130° C. The anhydrous product on analysis (ignition to the oxide) contained 17.32 per cent. copper; $(C_8H_7O_3)_2 Cu$ required 17.39 per cent. copper. The structure of the complex is given below:



The following procedure was adopted for the gravimetric estimation of copper:

The copper solution (neutral copper sulphate) was pipetted out into a beaker, acidified with dilute hydrochloric acid, diluted to about 100 c.c., an excess of solid resacetophenone (0.4 g.) added and the solution heated to boiling. Sodium acetate (15 c.c.: 35 per cent. solution) was gradually added with stirring. The precipitate was digested on a hot plate for an hour, filtered hot through a sintered glass crucible (No. 3) and washed with hot water till the filtrate was free from resacetophenone (ferric chloride colour reaction). The precipitate was dried to constant weight at 130° C. (two hours).

Typical results are recorded below:

| Copper | | Error % |
|-------------|-------------|---------|
| Taken (mg.) | Found (mg.) | |
| 64.5 | 64.2 | -0.5 |
| 64.5 | 65.0 | +0.8 |
| 64.5 | 64.0 | -0.8 |
| 64.5 | 64.9 | +0.6 |
| 64.5 | 64.5 | 0.0 |
| 64.5 | 64.3 | -0.3 |
| 32.2 | 32.2 | 0.0 |
| 32.2 | 32.0 | -0.6 |
| 16.1 | 16.1 | 0.0 |

The maximum error is 0.8 per cent. on amounts of copper ranging from 16-65 mg.

The author wishes to thank Professors V. Baliah and K. Neelakantam for their kind interest in the work.

Dept. of Chemistry, V. V. RAMANUJAM.
Annamalai University,
Annamalainagar, September 18, 1953.

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TOXIC EFFECTS OF SANGUINARINE

OIL extracted from the seeds of argemone mexicana has been incriminated as the cause of epidemic dropsy for a long time which has further been supported by the epidemiological studies and animal experiments of Lal^{1,2} and Chakravarti and Chaudhuri.³

Experiments similar to those of Sarkar⁴ produced 82 per cent. mortality in one batch of albino rats and 75 per cent. in another batch with an average L.D. of 78.5 as against 100 of Sarkar.⁴

Our next objective was to assess the effects produced on rhesus monkeys by pure sanguinarine hydrochloride and alkaloid-free argemone oil prepared by Roy⁵ and confirmed by Bailey⁶ (private communication).

A group of rhesus monkeys weighing 5-6 lb. was divided into 6 batches. To one batch 1 ml. of alkaloid-free argemone oil was given orally every sixth day, to another a similar dose was given by injection at the same interval, while to the third batch the same dose was given orally every day. To the fourth batch 0.44 mg. of sanguinarine hydrochloride was injected daily, to the fifth every sixth day and the sixth batch was given the same dose orally every day. The animals were observed for 65 days and no toxic effects were manifested

in them. At this stage the solution of sanguinarine hydrochloride was again tested on albino rats and found to retain its lethal potency. The dose of sanguinarine hydrochloride was increased to 1 mg. From the sixty-sixth day, to batch No. 1, 1 mg. of sanguinarine hydrochloride was injected every fifth day for 102 days with no effect, while to batch No. 2, 1 ml. of pure argemone oil was given by injection and the animal developed swelling of hands and feet on the thirtieth day.

It was also observed that when sanguinarine hydrochloride was injected intraperitoneally to 5 albino rats in a dose of 25 µg. per 100 g. body weight daily for 43 days, there was no effect; rather their body weight increased. Three batches of guinea pigs, 6 in each, were taken. To one pure argemone oil, to another alkaloid-free argemone oil and to the third pure mustard oil in a dose of 0.3 ml. per day was given orally for 40 days with no effect, and the animals gained in weight.

From the above it is concluded that (a) with a dose of 2 mg. of sanguinarine hydrochloride per 100 g. body weight, only 78.5 per cent. of albino rats died; (b) alkaloid-free argemone oil had no effect on the rhesus monkeys; (c) of the substances present in pure argemone oil, 0.44 mg. of sanguinarine (the amount present in 1 ml. of the oil) or 1.0 mg. of the substance in aqueous solution did not produce any morbidity in the monkeys. From these one may deduce with reasonable certainty that with the doses used by us neither alkaloid-free argemone oil nor sanguinarine hydrochloride produced manifestations of human epidemic dropsy in rhesus monkeys. The purity of sanguinarine hydrochloride was confirmed by Bailey⁷ of Dyson Perrins' Laboratory, Oxford. Further work is in progress.

Our grateful thanks to Professor B. Narayan for his interest and to the Bihar Board of Medical Research for a grant to carry out the investigations.

Public Health Lab.,

Patna-4,

May 4, 1953.

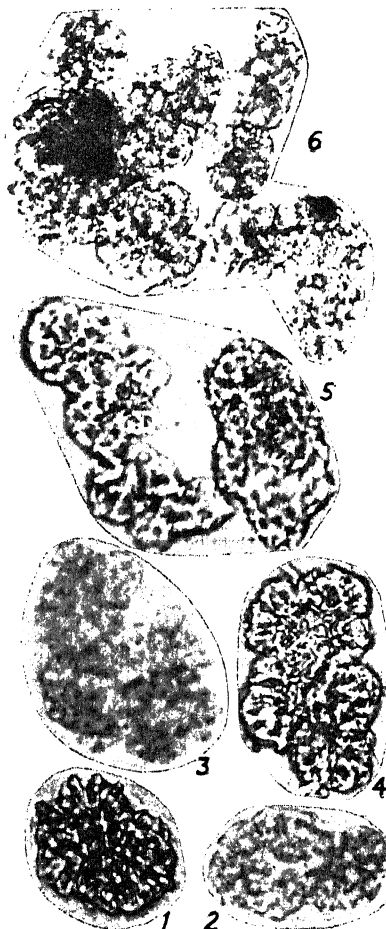
S. B. LAL.

A. C. ROY.

G. ACHARI.

OCCURRENCE OF BOTRYOCOCCUS IN EOCENE LIGNITES OF CUTCH

ABOUT a mile north of Waghapadar (23° 29' lat.; 68° 45' long.) a small village in Cutch, Western India, there occurs a lignitic bed, which is regarded by Wynne¹ and also Nuttall² as Middle Kirthar (Eocene). This lignitic bed is overlain by a bed of carbonaceous shales; this in turn is overlain by gypseous shales. From the above beds some samples were collected by Mr. B. S. Tewari and kindly made over to me for study. These pieces of lignite were macerated in pure nitric acid for about a week, washed in distilled water, centrifuged and treated with 10 per cent. solution of KOH for about an hour. They were finally washed, centrifuged and mounted in pure glycerine. A careful examination of all the slides showed that there were no other microfossils except numerous colonies of cells, yellowish or yellow green in colour. These colonies are round (Fig. 1) or concave, or several such are con-



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nected together into a compound colony, often round a central cavity (Figs. 2-6). The colonies range from 10μ to 150μ in size. The outlines of the individual cup or thimble in which the cells are placed are clear and in some cases even the undivided contents can be seen (Fig. 1). Microtome sections were made to elucidate this point further but without success. Staining the colonies with Gentian violet and Safranin was also not helpful. In appearance, structure and dimensions, the microfossils are remarkably like the oil-bearing brackish water alga *Botryococcus braunii*. This alga, according to some, is known in a fossil state from the Ordovician onwards. In India *B. braunii* has also been reported from the Eocene beds of Palana in Bikaner.³ *B. braunii* has also been recently reported from the Tertiary (Oligocene and Miocene) deposits of Australia.¹ The occurrence of *B. braunii* in these Cutch lignites supports the Eocene age attributed to these beds on the basis of other geological and palaeontological(?) data. So far as I am aware, the occurrence of this alga in the lignites of Cutch has not yet been reported.

My thanks are due to Dr. A. R. Rao for his guidance and criticism, to Prof. S. R. N. Rao for his constant encouragement and help and to Mr. Tewari for the material. This work was carried out during the tenure of a Government of India Senior Research Scholarship.

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AGMATITES IN BUNDELKHAND GRANITES AND GNEISSES AND THE PHENOMENON OF GRANITISATION

THE Bundelkhand granite of the type area, which has been correlated with Berach river granite of Mewar by Heron,¹ is supposed to be the oldest rock of India. Heron regards the Berach granite as pre-Aravalli, therefore, pre-Dharwar in age. During recent years Misra^{2,3} and his co-workers have carried out detailed geological study of these rocks in the districts of Hamirpur and Jhansi, and have clearly recognised the intrusive nature of Bundelkhand granite.

Misra⁴ pointed out the presence of hybrid gneisses in Mahoba ($79^{\circ} 53' : 25^{\circ} 10'$) area, resulting from the granitisation of the older schistose rocks. The remnants of these older schistose rocks are found in these granitic masses as black xenolithic patches as well as unattacked out-crops. Prof. Sederholm^{5,6} introduced the term *agmatite* to replace the terms 'eruptive breccia' and 'intrusive breccia' in his well-known memoirs on migmatites and associated pre-Cambrian rocks of South-Western Finland in 1923-26. The term refers to the fragments of older rocks, which occur cemented by granitic material. These agmatites have also been described by Hsing-Yuan Ma⁷ from the Rogart Migmatite area, Sutherland. Ma concluded that the two varieties of agmatites described from the Rogart area were formed *in situ* from solid rocks as a result of recrystallisation dependent on introduction, diffusion, fixation and expulsion of migrating chemical elements probably in ionic state.

In Bundelkhand, agmatites were first found in Kabrai area (Hamirpur District, Uttar Pradesh) in a small hillock on the eastern abutment of the Kabrai dam in the form of black xenolithic patches in granites and hybrid gneisses (Figs. 1 and 2). The outcrops are

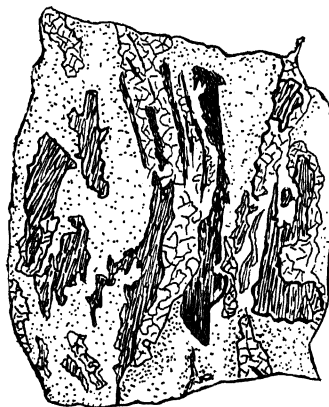


FIG. 1

FIG. 1. A sketch of a rock slab measuring $6' \times 4'$ exposed on the small hillock adjacent to the eastern abutment of Kabrai dam. The sketch shows stage in the granitisation of biotite schist (heavy black lines). Granitic cement stippled; pegmatitic veins shown by irregular mesh.

clearly exposed as a result of quarrying for aggregate material for the Kabrai dam.

These patches range from $1\frac{1}{2}''$ to $\frac{1}{2}'$ across. They represent remnants of unassimilated bio-

tite schist. The schistosity in some cases has been obliterated due to a certain amount of recrystallisation during the course of granitisation. They afford an excellent example of events which have taken place in the transformation of biotite schist into a biotite gneiss can be traced.

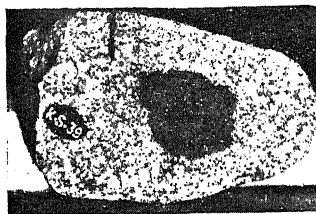


FIG. 2



FIG. 3

FIG. 2. Showing a dark patch of biotite schist in granitic cement. FIG. 3. Showing pygmatite vein in hybrid gneiss.

The colour of the schist fragments becomes lighter as the transformation takes place. This depends upon the progressive development of leucocratic lenticles of sodic plagioclases and quartz. Ultimately, the schist fragments fade out into the surrounding gneisses. Other features of granitisation like the presence of pygmatite veins (Fig. 3) may also be seen in the area.

Some of the gneisses retain original schistose fabric. The replacement of biotite schist by granitic material, the presence of agmatites and the presence of pygmatite veins suggest that these agmatites have developed *in situ*. They represent the patches of schist, which have escaped assimilation. It may also be concluded from the above that they merely represent a stage in granitisation.

These agmatites have also been observed at other places, viz., Kulpahar, Jhansi and Orcha in Bundelkhand. A more detailed account of these agmatites will be published elsewhere.

I am grateful to Dr. R. C. Misra under whose guidance this study has been undertaken.

Dept. of Geology, M. N. SAXENA.
Lucknow University,
Lucknow, August 1, 1953.

SEX CHANGE IN THE OVIPAROUS INDIAN BACKWATER OYSTER, *OSTREA MADRASENSIS* PRESTON

THE adult larviparous oysters are always hermaphrodite whereas the oviparous ones are of separate sexes. Following the discovery of a single hermaphrodite individual in one species of oviparous oyster by Kellogg,⁵ other workers, viz., Burkenroad,⁴ Loosanoff,⁶ Amemiya,^{1,2} Awati and Rai³ and Roughley⁸ have observed occasional change of sex in the American oyster, *Ostrea virginica*, the Portuguese oyster, *Ostrea (Gryphaea) angulata*, the Japanese oyster, *Ostrea gigas*, the Bombay rock oyster, *Ostrea cucullata* and the Australian commercial oyster, *Ostrea commercialis*. The sexuality of the Indian backwater oyster, *Ostrea madrasensis*, has not hitherto been studied. Since 1948 the present writer has examined over 4,000 specimens of adult oysters from different localities in the environs of the Madras City and the number of hermaphrodite ones noted in them is very small. Though some of them showed sperms and eggs when examined in the fresh condition, they have been in serial sections found to be of one sex only owing to the reason that the hermaphrodite regions of the gonad probably were not included in the sections. Clear hermaphrodite stages, however, were obtained in serial sections of material from two individuals collected from Ennur backwaters in the month of July 1953. Such individuals being very rare they are recorded owing to their scientific interest. The gonads of both these oysters when examined fresh showed fully ripe and motile sperms and eggs in all stages of development. In the serial sections of one of them (Fig. 1) the follicles close to the periphery and opening directly into the gonadal ductules showed eggs of larger size of which some were free within the lumina whilst those lying deeper down had eggs of gradually decreasing sizes proliferating from the lining epithelium. All follicles were fully packed with ripe sperms. In the second specimen (Fig. 2), the sections indicate that the formation of eggs has progressed much further as revealed by the presence of larger ones even in the deeper portions of the gonadal layer and the sperm masses of the lumina were less dense. Owing to the absence of developing spermatocytes in both the oysters and the presence of ova in varying stages including young oocytes, it is clear that the sex change is from male to female. The rarity of hermaphrodite individuals is fairly clear evidence that bisexual condition is purely transitional.

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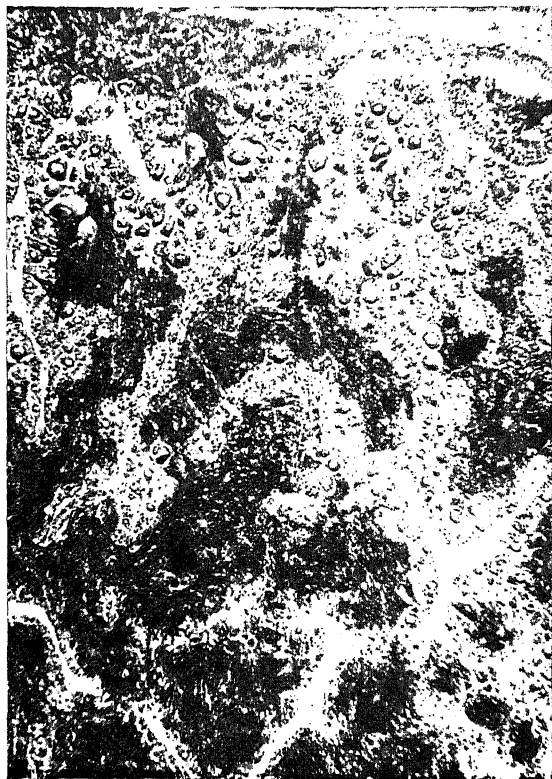


FIG. 1. Photomicrograph of section of gonad of *O. madrasensis* 130—Upper follicles with larger eggs and lower with smaller ones. Dark masses sperms.

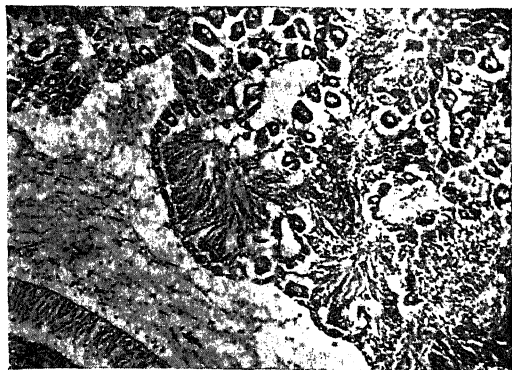


FIG. 2. Photomicrograph of section of gonad of *O. madrasensis* 160 showing large eggs and less dense masses of sperms in the lower follicles.

Table I shows the percentages of sexes in fortnightly samples of about 100 oysters examined every month from Ennur backwaters.

TABLE I

| Month | Males | Females | Indeterminate sex | Hermaphrodites |
|------------|-------|---------|-------------------|----------------|
| | % | % | % | % |
| March 1953 | 61.2 | 38.7 | nil | nil |
| April " | 59.77 | 40.23 | nil | nil |
| May " | 60.63 | 39.36 | nil | nil |
| June " | 57.44 | 34.04 | nil | 8.5? |
| July " | 42.16 | 52.94 | 0.98 | 3.9 |
| August " | 43.60 | 44.66 | 10.68 | 0.97 |
| Sept. " | 27.88 | 66.34 | 5.76 | nil |

From March to June the percentage of males in the samples is very high which, however, diminishes gradually commencing from July to September 1953. In September 1953 the percentage of females is as high as 66.34. As the main spawning season which is November-December (Rao⁷), approaches, the proportion of the females in the population seems to increase considerably. The number of hermaphrodite individuals met with being so small, it is doubtful whether all oysters that change their sex pass through this transitional phase. The occurrence of fair numbers of oysters of indistinguishable sex during the months preceding September shows that this species also changes its sex after passing through a stage in which the germ cells are undifferentiated into male or female components. A detailed study of the sex ratios and seasonal gonadal changes in *Ostrea madrasensis* in relation to the fluctuating environmental conditions is in progress.

The author's grateful thanks are due to Dr. N. K. Panikkar for his helpful criticism.*

Central Marine Fisheries K. VIRABHADRA RAO.

Research Unit, Madras-5,
October 12, 1953.

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp P.O.

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NUTRITIONAL REQUIREMENTS OF *TROGODERMA GRANARIA* EVERTS. (COLEOPTERA, DERMESTIDAE)

RECENT years have shown a great advancement in our knowledge of insect-nutrition. Importance of individual growth factors to insects has been shown by Subbarow and Trager,⁸ Sarma⁶ and Fraenkel *et al.*⁵ The work of various authors on the subject was reviewed by Trager.⁹

A study of nutrition of *Trogoderma granaria* Everts. was undertaken to explain restricted distribution of the insect on stored plant products. A semi-synthetic diet of known constituents was compounded after the manner described by Fraenkel and Bletwett.² It consisted of the ingredients in the following proportion and is referred to as 'complete diet' in text.

Casein (vitamin and fat-free), 50 parts; carbohydrate (glucose or soluble starch), 50 parts; cholesterol, 1 part; dried yeast, 2 parts; McCollum's salt mixture 185, 2 parts; water, 10 parts.

For *Trogoderma* this diet is as good as wholemeal flour of wheat on which larvæ take about 20 days to become adult at 35° C. and 45-50 per cent. humidity. Two batches of larvæ (0-24 hr. old and 8-9 days old) were grown on synthetic diet from which one ingredient was omitted each time and growth was compared with those fed on complete diet. Ten larvæ were kept

in small tubes containing approximately 2 g. of diet. Every test was performed in duplicate at 35° C. and 45-50 per cent. relative humidity. The results are graphically represented (Figs. 1 and 2).

As is seen in Fig. 1, growth of newly-hatched larvæ (0-24 hr. old) on complete diet is nearly as fast as on wholemeal flour of wheat. With diet in which cholesterol is absent the growth is not impaired but when salts are omitted the diet becomes inferior. Absence of protein adversely affects growth. Carbohydrates, particularly simple sugars are essential for proper development. Addition of starch in glucose-deficient diet stimulates growth but is not proved to be as efficient as glucose diet.

Addition of yeast is absolutely essential for survival and development but yeast alone is not a complete food of young larvæ which develop rather very slowly on it.

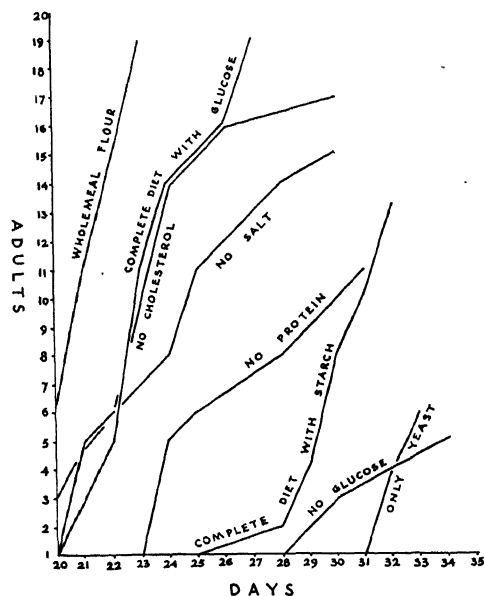


FIG. 1. *Trogoderma granaria*—Growth of newly hatched (0-24 hrs. old) larvæ on semi-synthetic complete and incomplete diets and on yeast and wholemeal flour.

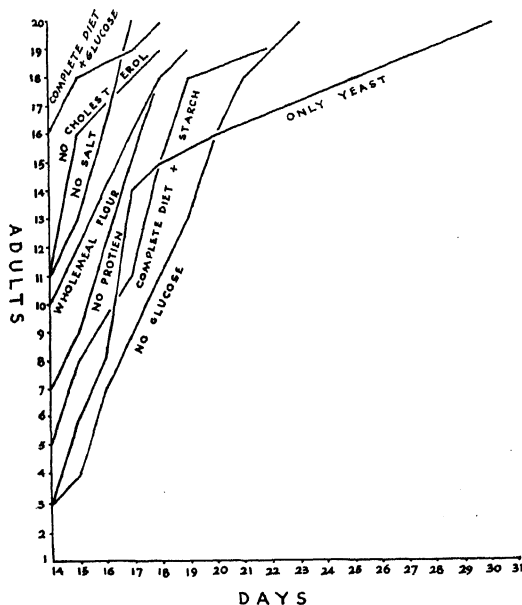


FIG. 2. *Trogoderma granaria*—Growth of larvæ which were fed on wholemeal flour with 5% yeast for 8-9 days before putting them on same combinations of diet as in Graph 1.

In another series of experiment (Fig. 2) larvæ were first allowed to feed for 8-9 days on wholemeal flour of wheat containing 5 per cent. dried yeast and were then transferred to different synthetic diets used in Fig. 1. It is interesting to find that this batch of larvæ behaves very differently as compared to previous batch. They grow normally without protein, glucose, cholesterol or salts but without yeast all larvæ die. Superiority of glucose diet

is also not manifested. The larvæ are able to develop on yeast. It is evident that due to pre-experiment feeding on wholemeal flour plus yeast insect is capable of meeting the deficiency of most of the basic factors of growth.

Trogoderma granaria requires proteins, carbohydrates, salts and vitamins for its normal growth. Cholesterol is apparently not necessary. Dried yeast is a poor food for newly-hatched larvæ but not so for 8-9 days' old larvæ. Some other store product beetles—*Tribolium*, *Ptinus*, *Sitodrepa* and *Lasioderma* have been found to grow normally on yeast.³ The possible explanation may be that *Trogoderma* needs simpler carbohydrates of which yeast is a poor source. Carbohydrates present in yeast are in form of highly polymerised polysaccharides^{4,7} which may be of no use to *Trogoderma* which cannot even grow on starch diet (Fig. 1).

Vitamins are absolutely necessary for the development of both batches of larvæ. Without protein growth is inferior for young larvæ but not so for older ones. It is likely that some of the protein requirements are met with the presence of yeast in diets. Similarly without salt mixture growth of young larvæ is slightly affected but older larvæ grow normally.

From the above results it is quite clear that the nutritional requirements vary according to the stage of development of *Trogoderma granaria* larvæ.

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Delhi, June 8, 1953.

N. C. PANT.

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SPEED OF FLIGHT OF DESERT LOCUST

A THICK pinkish-yellow swarm of the desert locust, *Schistocerca gregaria* Forsk., about two miles by one mile in size, was seen flying over a Lucknow suburb between 10.00 and 11.00 hours on May 19, 1953. The swarm came from south-west and moved towards Barabanki District (north-east) at about 11.00 hours. This swarm passed over Haidargarh Tahsil, District

Barabanki, between 13.00 to 15.30 hours and reached the southern portion of Faizabad District and started settling round about Haidarganj at 17.00 hours.

The distance of Haidarganj from Lucknow City via Haidargarh, as measured on the map of Uttar Pradesh and Delhi (Second Edition) published by the Surveyer-General of India is about 81 miles. The distance of 81 miles was covered by the swarm in about 6 hours, i.e., at an average speed of 13.5 miles per hour.

The same swarm after settling in and around Haidarganj village on the night of May 19, took to flight on May 20, 1953 at 9.00 hours in the south-eastern direction and reached Azamgarh City at 14.50 hours. The distance between Azamgarh City and Haidarganj as the crow flies is about 71 miles. It is not definite that the swarm moved in a straight line from Haidarganj to Azamgarh City, but it is certain that it covered a distance of not less than 71 miles in 5 hours 50 minutes and hence the speed of the locusts was not less than 12.2 miles per hour.

The wind velocity on May 19 and 20, 1953, at 14.00 hours was 4.6 and 4.75 miles per hour, respectively, as recorded in the anemometer at Lucknow. The general height of the flight of the locust swarm was about 600' above ground and hence at this elevation the speed of wind may have been greater. The maximum and minimum temperatures at Lucknow and Azamgarh on May 20, 1953, were 109° F. and 81° F. and 111° F. and 80° F. respectively.

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Section of Entomology,
Kanpur, U.P., September 14, 1953.

RELATION BETWEEN CHANGES IN SUSCEPTIBILITY AND VARIOUS FACTORS CONNECTED WITH SUCCESSIVE INSTARS OF THE DESERT LOCUST

THAT older instars of insects generally prove harder to insecticides than younger ones is, by now, a fairly established fact but the factors responsible for this increase in resistance have received little attention. The present investigation is an attempt to explore these factors in the case of Desert Locust, *Schistocerca gregaria* Forsk. as the increased resistance of the successive instars of this pest has been actually posing a definite problem to those engaged in its practical control. This note records in the table below the changes in comparative susceptibility indicated by the values

TABLE I

Comparative values of twelve factors in successive instars of *Schistocerca gregaria* Forsk.

| Factors studied | Actual value in 1st instar | Comparative value in instar No. | | | | |
|------------------------------------------------------------------------------|-------------------------------|---------------------------------|-------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 Median lethal concentration of crystalline suspension of gamma-BHC (% W/V) | 0.01657 | 1.00 | 1.72 | 4.19 | 7.46 | 15.26 |
| 2 Body weight per individual (sq. mm.) | 30.5 | 1.00 | 2.08 | 6.86 | 10.43 | 38.75 |
| 3 Surface area per individual (sq. mm.) | 144.2 | 1.00 | 1.14 | 3.53 | 5.83 | 8.56 |
| 4 Surface area per unit body weight (sq. mm./mg.) | 4.72 | 1.00 | 0.55 | 0.51 | 0.47 | 0.22 |
| 5 Body weight per unit surface area (mg./sq. mm.) | 0.2114 | 1.00 | 1.82 | 1.95 | 2.15 | 4.54 |
| 6 Percentage of wax in the exuviae | 15.5 | 1.00 | 0.513 | 0.299 | 0.234 | 0.195 |
| 7 Probable thickness of the wax layer (microns) | 0.86 | 1.00 | 0.78 | 0.36 | 0.5 | 0.798 |
| 8 Total protein percentage in the exuviae | 65.7 | 1.00 | 1.03 | 1.07 | 1.11 | 1.15 |
| 9 Cuticulin percentage in the exuviae | 11.25 | 1.00 | 1.238 | 1.259 | 1.321 | 1.261 |
| 0 Chitin percentage in the exuviae | 7.5 | 1.00 | 1.365 | 1.413 | 1.167 | 0.992 |
| 1 Weight per 100 exuviae (mg.) | 0.0832 | 1.00 | 1.764 | 4.327 | 12.59 | 39.62 |
| 2 Index of thickness of exuviae* | 0.0577 | 1.00 | 1.54 | 1.23 | 2.16 | 4.62 |

* Values of factor 11 divided by 100 and then by values of factor 3 and the quotient multiplied by 10^4 .

MLC (Median lethal concentration) and in even different factors, studied so far, which is likely to be responsible for increase in resistance.

For each factor, Table I gives the actual value obtained experimentally for the first instar as well as what has been called the 'comparative value' for different instars, making that of the first instar as unity. These comparative values have been obtained by dividing the actual values for different instars with the actual value for the first instar. The median lethal concentrations were determined using crystalline ($8 \times 10 \mu$ rhomboidal plate crystal) suspensions of gamma-BHC as rect spray under a precision spraying tower. The probable thickness of the wax layer has been calculated from the experimentally determined value of average weight of the wax per exuvium, the average surface area per individual of the same instar and the value of the specific gravity of insect wax (0.96) published by Lewkowitsch and Warburton.¹ The index of the probable thickness of the exuviae, on the other hand, has been calculated merely by dividing the average weight per exuvium by average surface area per individual of the same instar, the density of the exuviae not having been determined so far. The increase in these values, however, indicates that either the thickness of the exuviae or their compactness or both increase from instar to instar.

Of the factors studied, (a) surface area per unit weight, (b) percentage of wax in the exuviae, and (c) the probable thickness of the exuviae (which is also probably an index of the thickness of the cuticle), are most likely to affect the entry of the insecticide in different instars; it is noteworthy that they actually vary in the expected direction. The first two are negatively correlated with comparative MLC values and the third shows a positive correlation.

Division of Entomology,
Indian Agri. Res. Inst.,
New Delhi,
September 24, 1953.

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O. S. BINDRA.

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A REINVESTIGATION OF THE EMBRYOLOGY OF ARGEMONE MEXICANA

THE embryology of *Argemone mexicana* has been studied by Joshi,¹ Bose and Banerji,² Bose³ and Souèges,⁴ but since a complete account is not available, this work was taken in hand about a year ago.

A typical anther has 4 microsporangia, but occasionally 5-6 may be present. The tapetum is usually single-layered, but may become 2-3-layered at places. Its cells are multinucleate and the nuclei fuse to form irregular polyloid

masses. Bose² reported that pollen grains are shed at uninucleate stage, but my observations show that functional pollen grains are two-celled at the shedding stage.

The ovules are anatropous. The nucellus is crassinucellate and has a prominent beak. The epistase and hypostase are well marked and persist in the mature seed. Stomates are of common occurrence on the funiculus. The archesporium is not always single-celled as reported earlier,^{1,3} but may consist of a small group of cells. Both linear as well as T-shaped tetrads are formed.

The embryo-sac is of the Polygonum type. Earlier workers^{1,2} report that both the synergids invariably disorganise at the time of fertilization. I have, however, observed that in many cases one of the synergids persists even at the free nuclear stage of the endosperm. The polar nuclei fuse before fertilization in the chalazal part of the embryo-sac. The antipodals are larger than the cells of the egg apparatus. Previous workers^{1,2} stated that the disorganization of the antipodals sets in at the time of fertilization or during the formation of

the free nuclear endosperm. In my preparations, however, they were found even up to the cellular stage of the endosperm when the proembryo is at the globular stage. They not only persist but increase in size perhaps due to their haustorial activity.

A monosiphonous condition is usual but occasionally polysiphony as well as branching pollen tubes have been observed.

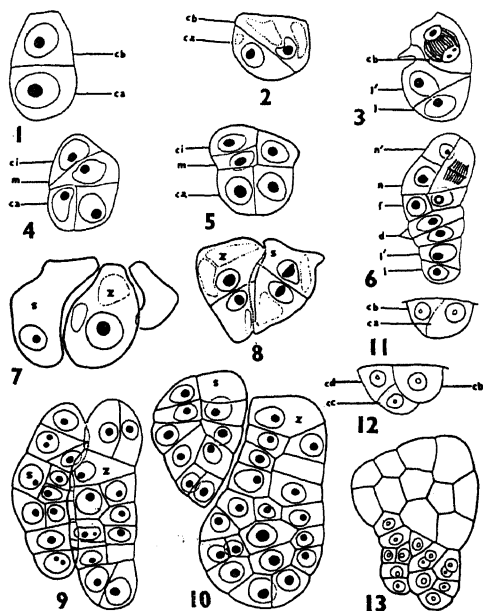
The primary endosperm nucleus divides much earlier than the oospore. No endosperm or embryo developed in bagged flowers. Joshi's statement that endosperm may be formed in the absence of the pollen tube and fertilization is not confirmed.

According to Souèges⁴ the zygote divides by an oblique vertical wall forming the cells *cb* and *ca* (Fig. 11). The cell *ca* divides obliquely to give rise to a three-celled proembryo comprising *cb*, *cc* and *cd* (Fig. 12). In my preparations the first division was generally followed by a transverse wall (Fig. 1), an oblique wall being much rare (Fig. 2). In its further development the proembryo shows great variability as shown in Figs. 3-6. These variations do not support the generalization of Souèges of a triad formation.

Souèges⁴ reported that sometimes a second rudimentary embryo is formed side by side with the normal embryo as the result of a proliferation of the suspensor (Fig. 13). I am able to confirm the occurrence of twin embryos, but find that while the larger proembryo is derived from the oospore, the smaller arises from the persisting synergid (Fig. 7). The latter may divide before or after the oospore, or both may divide simultaneously to produce twin two-celled proembryos (Fig. 8). Such twin proembryos may be observed long before the differentiation of the suspensor. Souèges has shown a common suspensor for the twin proembryos, 'whereas I find two distinct proembryos. In some cases they overlap each other, while in others they lie side by side (Figs. 9, 10).

In the mature seed there are only one or two layers of perisperm. The cells of the inner integument are crushed and absorbed. It is the outer integument which takes part in the formation of the seedcoat.

The seedlings have normally two cotyledons, but in some cases three were observed. Important facts found during this reinvestigation are: occurrence of two-celled pollen grains, persistent antipodals and synergid embryos.



S. synergid or synergid proembryo; Z. zygote or zygotic proembryo.

FIGS. 1-6. Early development of embryo, $\times 364$.

FIGS. 7-10. Stages in the development of twin embryos, $\times 470$.

FIGS. 11, 12, $\times 266$ and 13, $\times 329$. Reproduced from Souèges (1949), explanation in text.

I wish to thank Prof. P. Maheshwari and Dr. B. M. Johri for their kind encouragement and help.

Botany Department,
University of Delhi,
Delhi, September 23, 1953.

R. C. SACHAR.

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THE ENDOSPERM IN SOME CUCURBITACEAE

PREVIOUS embryological studies on this family¹⁻³ were based almost exclusively on microtome sections and therefore, some interesting features have been missed. I examined microtome sections as well as whole mounts and noticed the presence of a characteristic endosperm haustorium at the chalazal end. Such structures have often been overlooked in the past as pointed out by Maheshwari.⁴ Speaking of Kausik's⁵ work on Proteaceae he states: "The reason why the vermiform appendage had been missed by earlier workers is that they used only sections, which fail to give any complete picture of this organ, while Kausik used both sections and whole mounts and was, therefore, able to give a very thorough account of its development and organisation."

A short comparative account of the endosperm of the following is given here: *Blastania garcinii* Cogn.; *Coccinia indica* W. & A. (Syn. *Cephalandra indica* Naud.); *Citrullus fistulosus* Stocks; and *Cucumis sativus* L.

The endosperm is of the nuclear type. In all the genera except *Blastania*, the embryo sac elongates after fertilization (Figs. 1, 2). Its upper part broadens and becomes vesicular, while the lower remains narrow and elongates further, appearing like a tubular process (Fig. 8).

Wall formation is at first limited to the upper broader part of the embryo sac so that this region becomes cellular and may be referred to as the "endosperm proper" (Figs. 3, 9). The lower coenocytic tubular process extends downwards; its maximum length varies from 250 μ in *Citrullus* to 5,250 μ in *Cucumis*. In the latter the tip of the appendage is swollen (Figs. 12, 13) and often reaches down to the base of the nucellus. *Cucumis* is also characterised by the presence of a free nuclear bulbous portion between the cellular zone and the tabular haustorium (Fig. 12).

The haustorium shows dense granular cytoplasm with many free nuclei, and in some

cases abundant oil droplets (Figs. 4, 8). The nucellar cells around the appendage present a famished appearance and gradually their walls break down.

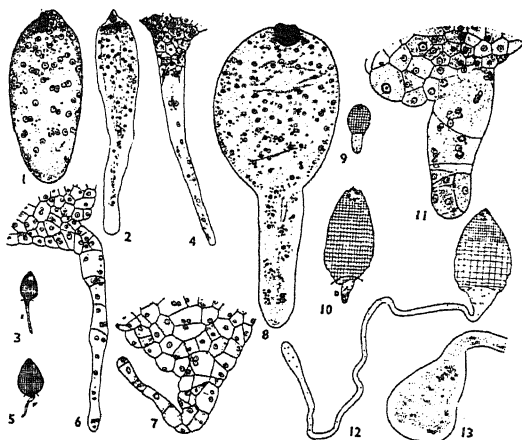


FIG. 1. Whole mount showing free nuclear endosperm of *Blastania garcinii*, $\times 67$.

FIGS. 2-7. Different stages in the development of endosperm in *Coccinia indica*; for explanation see text.

FIG. 4. is enlargement of part E marked in Fig. 3.

FIG. 6. is enlargement of part F marked in Fig. 5.

FIGS. 2, 4, 6 and 7, $\times 67$; FIGS. 3 and 5, $\times 15$.

FIGS. 8-11. Different stages in the development of endosperm in *Citrullus fistulosus*; for explanation see text.

FIG. 11. is enlargement of part D marked in Fig. 10.

FIGS. 8 and 11, $\times 67$. FIGS. 9 and 10, $\times 15$.

FIG. 12. Whole mount of endosperm of *Cucumis sativus*, showing long haustorium, $\times 15$.

FIG. 13. Terminal portion of another haustorium of *Cucumis*, $\times 31$.

The endosperm proper increases enormously in size especially at the base, and occasionally the marginal cells of this region bulge out prominently (Figs. 7, 11). The surrounding nucellar tissue is gradually consumed until only a few of its peripheral layers survive in the mature seed.

As regards the behaviour of the chalazal haustorium, in *Citrullus* and *Coccinia* it becomes partitioned by transverse walls to form chambers of different sizes containing a variable number of nuclei (Figs. 5, 6, 10, 11). Due to nuclear fusions large irregular polyploid masses are formed in some of the multi-nucleate segments (Figs. 7, 11). Secondary wall formation in the latter, which may be transverse, longitudinal or oblique produces a multiseriate structure. This cellular zone constitutes what may be termed secondary endosperm tissue in contrast to the primary endosperm tissue formed in the upper part of the embryo sac. In *Cucumis* the haustorium remains coenocytic.

In all genera in which the haustorium occurs, it attains its maximum size and activity at the

heart-shaped stage of the proembryo. In later stages its activity declines and by the time the embryo is fully differentiated the haustorium is no longer active. In *Cucumis* the haustorium shrinks and becomes coiled up, while in *Coccolinia* and *Citrullus* it gets appressed to the body of the endosperm proper.

The fully differentiated young embryo increases in size and matures at the expense of the endosperm tissue. The cell walls of the latter gradually gelatinise and collapse forming a viscous mass around the embryo. In the mature seed there is no trace of endosperm, and the massive cotyledons occupy almost the whole of the seed cavity.

It remains to be seen whether endosperm haustoria of the type considered here for the first time also occur in the families allied to the Cucurbitaceæ.

I take this opportunity to express my sense of gratitude to Prof. P. Maheshwari and Dr. B. M. Johri for their kind encouragement and help in connection with this investigation.

Botany Department,
University of Delhi,
Delhi, September 15, 1953.

R. N. CHOPRA.

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UNUSUAL POPULATION ERUPTION OF THE MOTH, *LYMANTRIA* *MATHURA* MOORE, IN AUTUMN

Lymantria mathura Moore (Lepidoptera, Family Lymantriidae) is a large moth whose caterpillars regularly defoliate the sal tree, *Shorea robusta*, in Assam and Northern India. Its other food-plants are *Eugenia jambolana*, *Quercus incana*, *Q. serrata*, *Terminalia arjuna* and *T. myriocarpa*.

In the forest area of New Forest Estate, about 4 miles from Dehra Dun, ca. 2,000 feet above sea-level at the foot of the Western Himalayas, the author noticed, about the middle of September 1953, the female moths in some numbers singly on tree trunks and on the walls of verandahs and other odd places, each sitting over an egg-mass. As days passed, the numbers increased and by the end of September and the first week of October, the whole of the forest area in New Forest was full of these moths in enormous numbers, all sitting quietly over egg-masses laid on the trunks of trees up

to a height of about 20-30' or a little more. The moths were usually single, but not infrequently they were sitting in groups of as many as 6 or 7, huddled together on the tree trunk. Some tree trunks 30' high and with a 3-foot diameter had as many as 50 or 60 moths on them. In some areas practically every tree was studded with numerous moths. The male moths were far fewer and only 3 were obtained in a day's collection; they were sitting quietly on the tree trunks but away from the female moths. The trees selected for egg-laying are normally the food-plants mentioned above, but during the present eruption eggs were laid on almost every plant available. The moths were equally common a few miles around, e.g., in and around Dehra Dun town, and in the Jhajra forest close by.

This unusual eruption has never been recorded before. The author has not come across the moth during the last 4 years of his stay (since 1949) in New Forest, Dehra Dun, and local residents (some of them being professional entomologists) observe that they have not seen this phenomenon, during the last 25 or 30 years of their stay in New Forest and Dehra Dun. In normal years the moth is not common and remains unnoticed. The erupted 1953 September-October generation of moths is the progeny of the summer generation, but in the summer and rains of 1953 (April-August) the moths were not at all conspicuous and none was collected.

A fuller account of the biology, etc., of this moth will be published elsewhere.

Entomology Branch, M. L. ROONWAL,
Forest Research Institute,
Dehra Dun, October 24, 1953.

CHROMOSOME NUMBER OF *ABELMOSCHUS TUBERCULATUS* PAL ET SINGH—A SPECIES RELATED TO THE CULTIVATED *BHINDI*

Abelmoschus esculentus (L.) Moench, commonly known as Lady's finger, *bhindi* or *okra*, is an important vegetable crop in India. Formerly, this plant was botanically called *Hibiscus esculentus* L. Recently Pal, Singh and Vishnu Swarup³ described from India a new species, *Abelmoschus tuberculatus* Pal et Singh, related to the *bhindi* plant. *A. tuberculatus* promises to be useful as breeding material as it is almost immune to the attack of the fruit-borer (*Earias insulana*) and also to the mosaic disease to which the common *bhindi* is susceptible. Although *A. tuberculatus* generally resembles *A. esculentus* in several vegetative and reproductive characters, Pal et al. considered

that, on the basis of some conspicuous morphological features and crossing behaviour, a specific rank for *A. tuberculatus* was perhaps justifiable.

The chromosome number of *A. esculentus* has been variously reported to be $2n=72$ (Teshima, 1933—quoted by Darlington and Janaki Ammal¹) and $2n=130$ (Skovsted⁴); in the variety, Sabour Selection, of this species the somatic chromosome number in root tip preparations was found by us to be 130. In Feulgen-stained root-tip-squash preparations of *A. tuberculatus*, more than a dozen very clearly analysable metaphase plates showed $2n=58$ chromosomes (Fig. 1); the root-tips, prior to

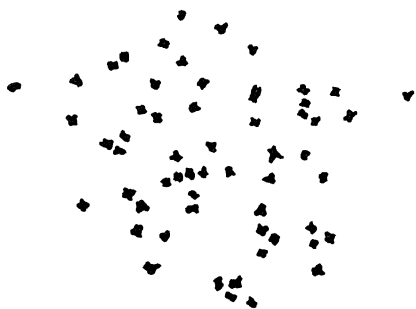


FIG. 1 (1750 ×)

fixation in 1:3 acetic alcohol, were immersed for 2 hours in a saturated aqueous solution of α -bromo-naphthalene for obtaining well spread out metaphase chromosome plates. Fig. 1 is an enlarged pen-and-ink drawing made from the actual photomicrograph ($\times 675$) by the photographic process described by Manton,² and it is seen that there are $2n=58$ chromosomes in one cell. This chromosome count in *A. tuberculatus* thus fully validates the recognition by Pal et al. of *A. tuberculatus* as a distinct species of *Abelmoschus*.

Pal et al. found the F_1 hybrid between *A. esculentus* and *A. tuberculatus* to be totally sterile, thus causing a setback in the utilisation of the latter species in the breeding programme. The present authors treated vegetative axillary buds on vigorously growing seedlings of the F_1 hybrid with 0.1 and 0.2 per cent. aqueous solutions of colchicine and have obtained a number of normal, viable-looking seeds from fruits set on the treated plants. Cytogenetical observations on the progeny raised from these seeds, as also the cytological features of the F_1 hybrid, *A. esculentus* \times *A. tuberculatus*, will be reported elsewhere.

We are grateful to Mr. H. B. Singh for seeds and seedlings of the two parental species and

of their F_1 hybrid and to Mr. P. N. Ghosh for assistance in photomicrographic work.

Division of Botany,
Indian Agric. Res. Inst.,
New Delhi, July 1, 1953.

A. B. JOSHI.
M. W. HARDAS.

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POLLEN GRAINS IN SACCHARUM AND CERTAIN ALLIED GENERA

APART from a study of the pollen grains in many of the Phanerogams and in fossils, grass pollen has come under intensive study and classification has been attempted on the basis of their size (Wodehouse,¹ Erdtman² and Jones and Newell³). Sampath and Ramanathan⁴ observed that pollen grains of certain cultivated species of *Oryza* are larger than those of the wild species.

Pollen grains of 4 species and certain hybrids of *Saccharum* (Co. canes) and 3 related genera, growing under similar conditions were studied by the writer in permanent Methyl-green glycerine jelly mounts. All the groups have spherical grains except *Narenga*. The mean diameters of 100 pollen grains are given in Table I.

TABLE I

| Species or groups | Average diameter of pollen grain (in microns) | Range in chromosome number (n) in the variants studied |
|-------------------------------|-----------------------------------------------|------------------------------------------------------------|
| <i>Sclerostachya fusca</i> | 29.6 \pm 0.22 | 15 |
| <i>Narenga porphyrocoma</i> | 30.6 \pm 0.19 | 15 |
| <i>Erianthus arundinaceus</i> | 30.6 \pm 0.37 | 30 |
| <i>Saccharum robustum</i> | 35.3 \pm 0.21 | 36 |
| <i>S. officinarum</i> | 37.6 \pm 0.40 | 40 |
| <i>S. spontaneum</i> | 39.6 \pm 0.30 | 27-60 |
| <i>S. Barberi</i> | 41.3 \pm 0.20 | 41-62 |
| Hybrids (Co. canes) | 45.5 \pm 0.24 | 59-62 |

All the differences between the various groups and species, except that between *Narenga* and *Erianthus*, are significant at the 5 per cent. level. The diameters range from 29.6 μ for *Sclerostachya* to 45.5 μ for the hybrids (Co. canes). *S. Barberi* seems to have the largest grains and *S. robustum* the smallest among the *Saccharum* species. Pollen grains of *S. sinense* were unfortunately not available during the past two seasons.

In *Narenga* the shape of the pollen grain is consistently ovoidal with the germ pore on the

broader side. *Erianthus* has smooth exine with a clear space between that and the intine. Pollen grains in *S. robustum* have frequently infertile grains with larger diameters than the mean, and a distinct spherical operculum. The large percentage of aborted pollen of variable sizes in *S. officinarum*, the rough and stippled exine and the prominent operculum in *S. spontaneum*, the distinct exine and intine and odd-sized infertile grains in *S. Barberi* are noticed to be characteristic. In the hybrids (certain Co. canes) studied, the large size evidently indicates their hybrid origin.

Thus, certain features of the external morphology of pollen grains can be of partial diagnostic value as between the species examined. Although the mean diameters vary with varieties within the same species, this variation is perhaps related to abnormal chromosome numbers, irregular meiosis, pollen abortion, etc. Recent work at this Institute (Rao and Balasubramaniam⁵) has revealed a positive correlation between chromosome number and pollen grain diameter in certain variants of *S. spontaneum*. The present studies appear to indicate the same trend extended to the species level (Table I). However, this has to be confirmed by a study of pollen grain size in the different variants within each species and group. The distinct difference in the shape of pollen grains in *Narenga* seems to add weight to the suggestion that this species is taxonomically well removed from *Saccharum* (Saradhy et al.⁶)

My grateful thanks are due to Shri N. L. Dutt for his kind help and guidance and to Shri R. R. Panje for going through the manuscript and making valuable suggestions.

Sugarcane Breeding Inst., A. S. ETHIRAJAN.
Coimbatore, August 22, 1953.

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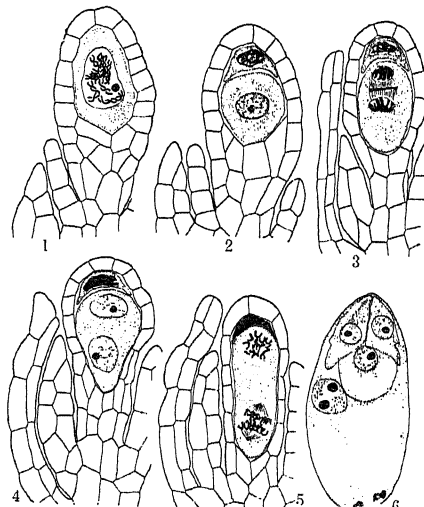
THE EMBRYO SAC OF XYRIS PAUCIFLORA WILLD.

THE only embryological work done so far in Xyridaceae is by Weinzieher¹ (1914) on *Xyris indica* L. He records a Polygonum type of embryo sac development besides other embryological observations. The present note deals with the development of the female gametophyte in *Xyris pauciflora* Willd.

The ovary is superior, tricarpeal and unicellular. A transverse section of a young ovary shows three hemispherical placentae of parietal origin protruding into the locule. The ovular

primordia develop as finger-like outgrowths from the placentae. Each primordium gives rise to an orthotropous, tenuinucellate and bitegmatic ovule.

A hypodermal archesporial cell becomes differentiated early. It enlarges and functions as the megaspore mother cell (Fig. 1). After the



FIGS. 1-6. *Xyris pauciflora* Willd. Figs. 1-5. I.S. of ovule with different stages of embryo sac development. Fig. 6. Mature embryo sac. All figs. $\times 485$.

first meiotic division it gives rise to the dyads (Fig. 2). The smaller upper dyad gradually degenerates and forms a darkly stained cap over the developing lower dyad (Figs. 3-5). The nucleus in the lower dyad divides; an ephemeral cell plate is observed on the spindle of this nuclear division (Fig. 3) but it disappears very soon (Fig. 4). The two nuclei move to opposite poles. A conspicuous central vacuole is not observed at this stage. This may be due to the spatial relationship. After two more nuclear divisions this bi-nucleate dyad gives rise to an eight-nucleate embryo sac. In the mature embryo sac the egg apparatus consists of a large egg and two comparatively small synergids (Fig. 6). The two polar nuclei fuse together and the secondary nucleus lies towards one side near the egg. The antipodals are ephemeral (Fig. 6).

It is therefore extremely interesting to note that the embryo sac development in the present species corresponds to the Allium type while it is of the Polygonum type in *Xyris indica*. A detailed paper on the embryology of *Xyris pauciflora* will be published elsewhere.

Grateful acknowledgment is made to Prof. L. N. Rao and Dr. S. B. Kausik for their guidance.

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Central College, Bangalore,

REVIEWS

Theory of Equations, Vth Edition. By H. W. Turnbull. (Revised 1952). Pp. xii + 166. Price 6 sh. Integration of Ordinary Differential Equations, VIth Edition. By E. L. Ince. 1952. Pp. viii + 146. Price 7 sh. 6 d. Tensor Calculus. By B. Spain. 1953. Pp. viii + 125. Price 8 sh. 6 d. (All published by Oliver & Boyd, Ltd., London. Agents in India: Macmillan.)

These are three of the recent publications in the series of "University Mathematical Texts" edited by Aitken and Rutherford. The first two are only revised editions while the book on Tensor Calculus is a welcome new addition.

Professor Turnbull needs no introduction to algebraists and his book on the theory of equations is as clear as it is brief and to the point. It deals not only with the theoretical aspects of the subject but also contains a description of practical methods of solution. Cubic and biquadratic equations are discussed in detail, together with more general types, but the relation to the theory of groups has been left out, as being beyond its scope.

The book on differential equations is a condensed version of Dr. Ince's larger treatise, with the more recondite theoretical aspects, such as existence theorems, left out. The book mainly deals with *methods* available for the integration of ordinary differential equations that are generally met with in mathematical physics. It is very clearly written, and can be readily followed by a person with a knowledge of the fundamentals of differential and integral calculus.

Tensor calculus does not appear to be taught systematically anywhere in this country either as part of a physics or a mathematics course. The book by Dr. Spain could well be an excellent text-book for study if such a special course is instituted. It deals with the fundamentals of tensor algebra leading up to the theory of geodesics and parallelism in curved space and the curvature tensor. The last three chapters are devoted to applications, (a) to differential geometry in ordinary three-dimensional Euclidean space, (b) the theory of elasticity, and (c) in relativity theory, including both special relativity and some problems in general relativity, such as the advance of the perihelion of mercury and the expansion of the universe.

They are well written, the only criticism that could be made is that in the chapter on elasticity the author restricts himself to isotropic media. In view of the increasing importance of crystal physics, a short account could have been included regarding the number of tensor components in crystals of varying degrees of symmetry. Also, since the book is more likely to be used by physicists rather than orthodox mathematicians, inclusion at various places of appropriate geometrical or physical explanations of the mathematical processes would have considerably enhanced the value of the book. For instance, the usual presentation of covariant differentiation as given in § 22 always leaves the feeling that the addition of the extra term to $\partial A^k / \partial x_i$ in the expression for $A^k_{;i}$ is a mathematical jugglery to obtain a quantity obeying the transformation law, which is of course not the case. However, these observations in no way detract from the value of the book, which has maintained the same high standard as its predecessors in the series.

The reviewer warmly commends these texts to every college teaching mathematics, and also physics, to an Honours or Post-Graduate standard.

Advances in Enzymology, Vol. XIV. Edited by F. F. Nord. (Interscience Publishers), 1953. Pp. x + 470. Price \$ 9.25.

This fourteenth volume of *Advances in Enzymology*, which is the latest addition to this well-known series, maintains the high standard and uniform excellence of its predecessors.

The opening article by Theodor Bucher gives a sound groundwork of the present-day concept of transport of energy within the living cell. After a preliminary discussion on the thermodynamical view-points on energy transport, the author summarises the recent work on ATP synthesis and similar investigations bearing upon energy provision and mechanism of oxidative phosphorylation. These various physical models and theories are dealt with and a short account of photochemical experiments with proteins is presented.

Details of the isolation, characterisation and physiological relationships of *Lactobacillus bulgaricus* factor (LBF) which was found to be

a conjugated form of pantothenic acid is given by Snell and Brown.

It has to be admitted that Lerner has been eminently successful in his attempt to summarise the important material from the vast amount of literature that has accumulated on the metabolism of phenylalanine and tyrosine. The mechanism of reactions by which these amino acids are converted into other biologically active materials and the properties of the related enzymes are discussed.

Of particular interest is the illuminating article on the oxidation of proteins by tyrosinase and peroxidase by Sizer who has made important contributions in this field. The next article by Langenbeck presents an authoritative treatment of the chemistry of organic catalysis and its application to enzyme chemistry.

Leloir gives a clear and concise summary of the concept of phosphate transfer and isomerisation in sugar phosphates in his review. In a thought-provoking article, Hoffmann-Ostenhof makes a strong plea for reorientation of the system of classification and nomenclature of enzymes on a more rational basis. This article which marks a departure in style and content from the others is quite easy. It is high time that enzymologists should give careful considerations to the suggestions made by the author.

A detailed account of the more recent techniques employed in the study of structure of proteins is given by Pierre Desnuelle. The last two chapters are concerned with methods used for the isolation and purification of proteins and enzymes. The principles and procedures for enzyme isolation are dealt with by Schwimmer and Pardee in a lucid and succinct manner; while Zittle confines himself to adsorption studies of enzymes and proteins.

Although there is some overlapping of material in the last three chapters, these articles are well documented and the reviewer feels that they fill in a definite need for an exhaustive compilation of methods in Enzymology. This is an excellent feature of this volume and it is hoped that more space will be allotted to methodology of enzymes in the succeeding volumes.

A cumulative index for Volumes I-XIV is provided at the end of the book. The publishers have maintained their reputation for the excellence of the printing and production. The book provides excellent material for research workers in the field of enzymes and proteins.

K. V. GIRI.

Annual Review of Biochemistry, Vol. 22. Edited by J. Murray Luck. (Annual Reviews, Inc.), 1953. Pp. ix + 729. Price \$6.00.

Even though several topics, which used to be covered by the *Annual Review of Biochemistry*, have been transferred since 1950 to different annual publications, the progress in biochemistry has been so rapid that the volume under review is quite as large as any of its predecessors. Attention may be drawn at the very outset to two new features in the present volume. The chapter on vitamins has grown enormously in size and the editors intend to increase the number of pages to be so devoted in the volume appearing next year. Secondly, this volume carries for the first time, an introductory chapter by Prof. McCollum, the doyen among biochemists in the United States, who draws largely on his rich and varied experience to give an account of his early work in the field of foods and nutrition.

There are twenty-two chapters other than the prefatory article by McCollum, and these have been written by biochemists drawn from the different laboratories in the United States, Europe and Argentina. The articles are usually accustomed to find in the *Annual Review* are there: such as biological oxidation, proteolytic enzymes, non-oxidative and non-proteolytic enzymes, chemistry of carbohydrates, lipids, amino acids, peptones and proteins, nucleic acids, purine and pyrimidines, carbohydrate metabolism, lipid metabolism, metabolism of amino acids and proteins, nutrition, fat soluble vitamins and water-soluble vitamins. All these articles have been ably written and cover very well the literature on the specified subjects except perhaps that by Hesrin, who deals only with glycosidases among the non-oxidative and non-proteolytic enzymes and that by Hilditch, who states at the very beginning of his article that his review on the chemistry of lipids is selective and not comprehensive. Further, Isbell and Frush who have written on the chemistry of carbohydrates have drawn for their review, material, which is largely found in the special reports of the U. S. Atomic Energy Commission and the National Bureau of Standards.

The special topics which have been included in this volume are the chemistry of cortisone, neoplastic tissue and fungi as well as the biochemistry of teeth, antibiotics and vision. Immunopolysaccharides, ruminant nutrition and photosynthesis have also been dealt with in separate chapters.

There is in the end a comprehensive author and subject index and the volume as a whole is remarkably free from errors except for three misprints on pages 372, 413 and 617 respectively. A preponderance of references to American literature is noticeable in view of the remarkable progress of biochemical research in the United States. But, it is felt that the editors and reviewers alike should make every effort to collect the cream of biochemical literature published every year in other parts of the world as well and endeavour to make the volume truly comprehensive in character. However, even in the present form, the *Annual Review* is not very far from that perfection, and with a reasonably low price of six dollars, should prove a real acquisition to all those who are interested in the rapidly advancing subject of biochemistry and nutrition.

P. S. SARMA.

The Manufacture of Compressed Yeast. 2nd Edition. By F. G. Walter. (Chapman & Hall), 1953. Pp. x + 317. Price 37 sh. 6 d. net.

The manufacture of food yeast graduated into a matter of great practical import in Germany during the recent world war. Widespread interest in this question received a fillip in other countries when information on the progress made in war-time Germany became available through the reports of the FIAT, the CIOS and the BIOS. A considerable volume of literature has now grown both as regards improvements in the existing methods of production as well as the exploitation of newer and cheaper raw materials. One would therefore expect that in bringing out a revised text after the lapse of more than 12 years, full advantage would have been taken of the occasion to make the work under review both authoritative and up to date. In this respect, the book is rather disappointing, and one suspects that the author has been much too preoccupied with his own contributions to be free to consider the work of others. Had an extensive bibliography been appended, this defect would have been offset to some extent. As it is, no encouragement is offered to the serious student desirous of pursuing the subject further, beyond the cryptic statement that opportunities "for further research in the industry are by no means exhausted" (p. 163).

One wonders whether the introductory chapter on yeasts, etc., did not deserve a more accurate treatment, perhaps in collaboration with a biochemist. This would at least have enabled avoiding repetition from the earlier edition of statements like "Alcoholase, the zymase of yeasts, splits sugar into alcohol and carbon

dioxide" (p. 24); or, "How the change actually occurs is not known because different fermentations occur simultaneously in the yeast cell and all the changes that take place are unknown....." (p. 4). The exact connotation of the term "fermentations" in the above statement is not clear. The statement that growth of yeast and alcohol production "are mutually exclusive" (p. 165) would come as a surprise to students of Pasteur effect. Another in similar vein is the following: "A simple experiment quickly demonstrates that the yeast cell is incapable of dissociating alcohol, as it does sugar, for the purpose of using its carbon in these synthetic anabolic processes or as a source of energy" (p. 164). Apart from the evidence available in current literature, the fact that the author in his patent process (pp. 168-69) has adopted aeration of the suspended seed yeast to get rid of the alcohol, itself mitigates against such an assertion. In any case no proof has been adduced to show that the "discharge of alcohol" under such conditions is not due to its utilisation as a source of carbon.

The get-up of the book conforms to the usual high standards of the publishers, though the price appears to be a little high.

S. DURAISWAMI.

Use of Antibiotics in Tropical Diseases. (*Annals of the New York Academy of Sciences*, Vol. 55, Art. 6). Edited by Roy Waldo Miner. (Published by the Academy, New York), 1952. Pp. 967-1,284. Price \$4.00.

Readers of medical periodicals are sometimes baffled by reports from different parts of the world, giving divergent data on responses to antibiotic treatment for the same disease. One reason for the varying results is presumably due to variations in biological strains of apparently same pathogenic organisms. For instance, the same antimalarial drug proguanil, sometimes gives different results in *Plasmodium falciparum* infections in India, West Africa and the Pacific Islands. Hence the need to 'bring all these data from the far corners of the world and to organise, digest and evaluate' is acutely felt.

The monograph deals with the value of different antibiotics in typhus, typhoid, dysenteries, cholera, plague, trepanematosi, among other tropical diseases, as also the scope of antibiotics in veterinary medicine. Diseases like malaria and leprosy that have not given satisfactory response to any antibiotics so far, have also been studied. The scope of the monograph has therefore been fairly exhaustive.

This authoritative 'document' should therefore be consulted both by those who are antibiotic enthusiasts for its sobering effect, as also by therapeutic nihilists who may need salutary stimulation to wean them from scepticism. Therapeutic medicine should be gratified by the publication of this precious number of the *Annals*.

V. ISWARIAH.

Catalogue of Indian Insects. Part 27 (*Isoptera*).

By Rattan Lal and Ram Das Menon. (Published by the Manager of Publications, Delhi), 1953. Price Rs. 7-2-0.

The catalogue under review is one of the useful series of entomological publications issued under the auspices of the Indian Council of Agricultural Research. The present one is Part 27 of the series and deals with *Isoptera* or Termites—better known under the popular appellation of 'white ants'—pests, with whose insidious activities the denizens of the tropics and semi-tropics are but too familiar. The depredations of white-ants on wooden structures, books and furniture in houses, on growing crops in the field and on timber trees in forests render them dangerous foes to human economy. Their concealed ways of life either underground or in the stems of plants render them difficult pests to control. On the other hand, the fact that they live in large social communities composed of enormous numbers of individuals of different castes, males and females (queens), workers and soldiers, with distinct life-functions, their ability to build large earthen structures—the anthills—to serve as nests for their young brood and the enormous powers of egg-laying possessed by their queen-ants, render them objects of fascinating interest.

While to the layman all kinds of 'white-ants' are the same, there are in reality quite a number of different species of termites, each having its own type of life-habits. In the present publication, the authors have listed over 150 forms collected from the different parts of India, Burma and Ceylon and there is little doubt that there are yet as many more, still remaining undiscovered in these countries. It is important to recognise that, in devising control measures against white-ant damage, it is essential to find out which particular species is concerned, as each species has its own ways of life and of breeding.

References to damage by termites in publications in the past have often been involved in confusion, since different species had been

mistaken one for the other; and the present catalogue will be found to be of great help to working entomologists in clearing up their synonymies.

It is regrettable, however, to find that a good many printing errors have crept into the body of the text, only some of which are found included in the list of *Errata* appended. But, all the same, there is little doubt that the catalogue will serve as a very useful reference book for field workers and the authors deserve every credit for the enormous amount of effort they have put in for bringing out this list.

Y. R. R.

Manual of Indian Forest Botany. By N. L. Bor. (Oxford University Press), 1953. Pp. xi + 441. Price Rs. 25.

An Indian teacher of botany compiling a list of books to recommend to his students gets on nicely until he comes to the general text-books, when he finds that there is really no comprehensive book that successfully deals with Indian systematic botany for advanced university students. With a feeling of disappointment, he turns to books by British and American authors and painfully discovers that they are so characteristically British or American as to be quite unsuitable for inclusion in his list. The *Manual of Forest Botany* by Bor is undoubtedly an exception and deserves special consideration because it deals entirely with Indian plants.

The book, as stated by the author in the preface, is the outcome of a course of lectures on forest botany delivered by the author to students of the Indian Forest College at Dehra Dun during 1938-42. It is a book for the teacher and the student, for use in the classroom as well as in the field. It has been compiled in the belief that the more flowering material the student handles, the sooner he will realize how easy it is to use keys for running down families, genera and species. He will get to know characters of families by experience, instead of learning them by heart and if he has an aptitude for taxonomy, will acquire that flair which enables him to place a plant instinctively in the right family.

An unusual departure from books on similar subject is the adoption of Hutchinson's system of classification in this *Manual*. The chapter on progress of classification (pp. 27-39) gives a concise but lucid history of the subject and the author's reasons for adopting this phylogenetic system. While due attention is given to the scientific aspects of classification and economic uses, the equally important field

characters (like characters of bark, colour of latex, etc.), which very often are the only means of identifying trees in a forest, are not neglected. After a detailed treatment of the Gymnospermæ, especially the Coniferales, about 72 families of the Angiosperms, both Dicotyledons and Monocotyledons, have been dealt with. This is followed by a very useful chapter (pp. 359-75) on 'Getting to Know the Trees', in which the author has tried to condense field characters of a large number of plants. The book concludes with a key to the families adopted for Dr. Hutchinson's well-known key to the families of Dicotyledons in the families of flowering plants and a comprehensive index.

The book is well produced and is bound to have a very large demand. The nomenclature is practically up to date and the illustrations, by the well-known botanical artist, Ganga Singh, are excellent and show the outstanding characters that will help in the identification of the species. The printing, both of the illustrations and the text, is very clear and pleasant. It would, however, have been more useful to print the illustrations on one side of the paper and insert them inside the text at appropriate places instead of putting them all at the end of the book.

Few persons are better qualified than Dr. Bor to write a book on Indian Systematic Botany and he may be said to have done the job exceedingly well. It is possible that the elementary student, or one who is concerned merely with 'passing' examinations, may find the book rather heavy, but to the genuine student and the teacher it will remain a mine of information for a long time. The price is probably beyond the reach of many of the Indian students and the possibility of bringing out a cheaper edition for use as text-book by the Universities of India may be considered.

M. B. RAIZADA.

Books Received

- Biological Transformations of Starch and Cellulose.* Edited by R. T. Williams. (Biochemical Society Symposia No. 10), (Cambridge University Press), 1953. Pp. 84. Price 10 sh. 6 d.
- Geological Maps.* By G. W. Chiplonkar. (Dastane Brothers' Home Service Ltd.), 1952. Pp. iv + 92. Price Rs. 7-8-0.
- Crystal Growth and Dislocations.* By Verma. (Butterworth Scientific Publications), 1953. Pp. xii + 182. Price 30 sh.

- Investigations in the Band-Spectra of Some Diatomic Hydrides.* By Bengt Kleman. *Growth Yield and Nutrition in Carpets of Forest Moss Hylocomium Splendens.* By Carl Oloftamm. (Thesis, Stockholm), 1953.
- Fats and Oils (A Series of Monographs), Soap Manufacture, Vol. I.* By A. Davidsohn, E. J. Better and J. Davidsohn. (Interscience Publishers), 1953. Pp. xii + 525. Price \$12.50.
- Selected Chapters from Modern Inorganic Chemistry.* 2nd Edition. By K. K. Dole. (Dastane Brothers' Home Service Ltd.), 1953. Pp. viii + 634. Price Rs. 13-12-0.
- Timber—Its Structure and Properties,* 3rd Edition. Revised. By H. E. Desch. (Macmillan & Co.), 1953. Pp. xxiii + 350. Price 25 sh. net.
- Television Receiver Design (2) Flywheel Synchronization of Saw-Tooth Generators.* By P. A. Neeteson. (Phillips' Technical Library), (Philips House, Calcutta 20), 1953. Pp. 156. Price not given.
- Pharmacognosy of Ayurvedic Drugs (Travancore-Cochin).* (The Central Research Institute, University of Travancore), 1953. Pp. iii + 104. Price not given.
- Radio Engineering, Vol. I. (Second Edition).* By E. K. Sandeman. (Chapman & Hall), 1953. Pp. xxiv + 779. Price 60 sh. net.
- Infra-Red Absorption Spectra of Steroids (An Atlas).* By Konard Dobriner, E. R. Katzenellenbogen and R. Norman Jones. (Interscience Publishers), 1953. Price \$11.50.
- Electroanalytical Chemistry.* By James J. Lingane. (Interscience Publishers, Inc.), 1953. Pp. ix + 448. Price \$8.50.
- Standard Methods of Clinical Chemistry, Vol. I.* Edited by Miriam Reiner. (Academic Press, Inc.), 1953. Pp. xii + 142. Price \$4.50.
- The Proteins—Chemistry, Biological Activity and Methods, Vol. I. Part B.* Edited by Hans Neurath and Kenneth Bailey. (Academic Press, Inc.), 1953. Pp. ix + 549-1,115. Price \$13.00.
- The Indian Pharmaceutical Codex, Vol. I. Indigenous Drugs.* By B. Mukerji. (C.S.I.R.), 1953. Pp. x + 431. Price Rs. 12.
- Poisonous Plants of India.* By Ramnath Chopra, R. L. Badhwar and S. Ghosh. (I.C.A.R.), 1949. Pp. xxvii + 762. Price Rs. 30.
- The Origin of the Earth.* By W. M. Smart. (Cambridge University Press), 1953. Pp. vi + 239. Price 18 sh. net.
- Industrial Inorganic Analysis.* By Roland S. Young. (Chapman & Hall), 1953. Pp. viii + 368. Price 36 sh. net.

SCIENCE NOTES AND NEWS

Conference on Defects in Crystalline Solids

The H. H. Wills Physical Laboratory of the University of Bristol, in co-operation with the International Union of Pure and Applied Physics and with the Institute of Physics, is organizing a conference on "Defects in Crystalline Solids" to be held from 13-17 July, 1954, in Bristol. While not excluding other subjects in the field the organizers propose to give particular attention to defects such as dissolved atoms, vacancies and F-centres, to microwave resonance methods of investigating their properties, and to the way in which they react with dislocations. Thus dislocations will be discussed in their chemical aspects, as influencing diffusion and precipitation in the solid state, rather than in relation to plastic flow.

Further particulars may be obtained from the Secretary, H. H. Wills Physical Laboratory, Royal Fort, Bristol 8, or from the Secretary, The Institute of Physics, 47, Belgrave Square, London, S.-W. 1.

High Speed Electrical Recorders

The Light Point Line Recorders developed by Messrs. Hartmann & Braun AG, Germany, have built-in galvanometers for frequencies up to 100 cycles per second and are applied in all cases where low D.C. currents or voltages and rapidly changing conditions need be recorded by a photo curve without the use of amplifiers. A light source of high pressure mercury vapour lamp and special photographic paper produce a recording which is immediately visible without developing or fixing the paper chart. The brightness of the luminous points is so intense that even at recording speeds of 10 m. per second, the light point raised is clearly visible. Interchangeable measuring movements having various sensitivities and frequencies are provided for different measuring methods. Two types RLt.1 and RLt.4 for 1 and 4 recording movements respectively are available.

Indian Science Congress, 1954

Professors L. Pauling (U.S.A.), F. C. Bawden (U.K.), A. M. Bateman (U.S.A.), N. Wiener (U.S.A.), J. Huxley (U.K.), E. B. Chain (Rome), P. C. Young (UNESCO, Delhi),

T. Dalling (Rome), F. J. M. Stratton (U.K.), are expected to participate in the 41st Session of the Indian Science Congress to be held in Hyderabad in January 1954. A programme of lectures, technical and popular, has been arranged to be delivered by them.

Radioisotope Conference

A Radioisotope Conference arranged by the Atomic Energy Research Establishment, Harwell, is to be held in Oxford during the week 19-24 July 1954. On the first three days of the Conference papers presented will deal with applications in medicine, biology and agriculture. The remainder of the meetings will be concerned with chemical, physical, engineering and general industrial applications. In medicine it is intended to deal with the experimental uses of the radioisotopes.

An exhibition of instruments and techniques of interest to radioisotope users will be held in Oxford during the Conference. Further details and application forms can be obtained from the Conference Secretary, AERE, Harwell, Didcot, Berks.

Award of Research Degree

The Allahabad University has awarded the Ph.D. Degree in Botany to Sri. Gadadhar Misra for his thesis entitled "Photoperiodism and Vernalisation in Some Indian Varieties of Rice and Wheat".

The Bombay University has awarded the Ph.D. Degree in Physics to Sm. V. Rajeswari for her thesis entitled "Swan Bands in Rare Gases".

The Gujarat University has awarded the Ph.D. Degree in Chemistry to Sm. Hemlata J. Kazi for her thesis on "Studies in Emulsions and Interfacial Tension and Complex Formation".

Royal Institute of Chemistry, Deccan Section

At the Fourth Annual Meeting of the Deccan Section of the Royal Institute of Chemistry held recently, the following officers were elected for 1953-54: *Chairman*: Dr. C. V. Natarajan; *Vice-Chairmen*: Professor K. R. Krishnaswamy and Dr. B. H. Iyer; *Hon. Treasurer*: Dr. M. R. Aswathanarayana Rao; *Hon. Secretary*: Dr. R. Rajagopalan.